

Prime Hook National Wildlife Refuge
Fire Management Plan
2002

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I. Introduction

A. Purpose and Need

The Department of Interior (DOI) fire management policy requires that all national wildlife refuges with vegetation that can sustain fire have a management plan. The plan must detail fire management guidelines for operational procedures and values to be protected and enhanced. This Fire Management Plan (FMP) for the Prime Hook National Wildlife Refuge (the Refuge) will provide guidance on preparedness, prescribed fire, wildfire, and prevention. Values to be considered in the Fire Management Plan include: protection of Refuge properties, structures and improvements, cultural and historical sites, protection of neighboring private properties, protection of endangered, threatened, and species of special concern, and enhancement of Refuge habitats. The FMP will be reviewed periodically to ensure the fire program advances and evolves with the US Fish and Wildlife Service (FWS) and the Refuge mission.

See Appendix C. for specific authority and guidance for implementing this plan.

B. Fire Management Objectives

The following considerations were used to develop the Prime Hook NWR fire management goals and objectives, as outlined by refuge mandates and refuge system organic legislation.

1. Considerations

- I. Fire is an essential option for maintaining the refuge's native biotic communities.
- II. Prescribed fire has positive effects on vegetation, wildlife, and cultural resources when utilizing the appropriate burning conditions, techniques, and principles of plant phenology.
- III. Uncontrolled wildfire has the potential for negative impacts (out of season, wind events, fire trespass, burning onto neighboring properties...).
- IV. The "light hand on the land" or minimum impact suppression tactics should be implemented to minimize environmental damage.

2. General Fire Management Objectives

- I. Protect life and resources / property.
- II. Use prescribed fire for hazard fuel reduction and habitat enhancement.
- III. Restore fire as a natural ecological process in Prime Hook NWR ecosystems.
- IV. Safely suppress *all* wildland fires using strategies and tactics appropriate to safety considerations and values at risk (fire use for resource benefit is not feasible).
- V. Provide for and protect habitat for endangered, threatened, and species of concern.
- VI. Prevent human-caused wildland fires.
- VII. Educate the public regarding the role of fire within the Refuge.

3. Specific Fire Management Objectives

Prime Hook NWR does not have a Master Plan, nor a Comprehensive Conservation Plan, as of the date of this document. The Specific Refuge Fire Management Objectives outlined in this document are drawn from refuge-specific enabling legislation, the Endangered Species Act, and the Refuge Improvement Act. Prime Hook NWR was established under the Migratory Bird Conservation Act (16 U.S.C. 715-715r) as amended, on August 21, 1962, "... for use as an inviolate sanctuary, or any other management purpose, for migratory birds."

The following operational objectives proceed from PHNWR enabling legislation, national legislation, and PHNWR Refuge purposes:

1. *Provide resting habitat and food resources for migratory birds, especially migrating and wintering waterfowl, shorebirds, marsh and wading birds.*

Refuge marshes are a major stopover point on the Atlantic Flyway. Rotational applications of prescribed fire in emergent marshes may enhance waterbird habitat, by reducing dense litter accumulations, increasing structural diversity, and stimulating certain food-producing plants. Fire also may be used to help eradicate invasive plants, such as *Phragmites australis*, in combination with chemical herbicides.

2. *Preserve, restore, and enhance in their natural ecosystems, species of animals and plants that are endangered or threatened.*

Prescribed fire can restore rare, fire-dependent ecosystems (Tyndall 1992) and the declining or rare wildlife that inhabit them. Prescribed fire may reduce threats of catastrophic wildfires through hazard fuel reduction, and protect critical habitats for declining species.

3. *Manage forested and grassland habitats for other nesting and migrating species of waterfowl, shorebirds, Neotropical land birds, breeding forest interior and grassland birds, and native resident wildlife.*

Fire may be used to restore certain Refuge forest habitats, used by neotropical forest interior birds, to a more natural structure and vegetative composition. Fire can also be used to restore early successional habitats for declining grassland and shrubland breeding birds. Fire may be used to help eradicate exotic, invasive plants from Refuge lands, such as introduced cool season grasses, and may reduce the need to use chemical herbicides or reduce the amount of chemicals needed to control invasive species.

4. *Provide hunting, fishing, wildlife observation and photography, and environmental education and interpretation opportunities for refuge visitors as priority uses.*

Some prescribed fire projects will be conducted in areas accessible to the general public. The refuge can take advantage of opportunities to inform and educate the general public, and to alleviate concerns they have related to fire. This can be addressed through interpretative signs and displays on site, and guided field trips which explain fire's role in eastern ecosystems. Classroom programs and talks, targeting various ages groups, can explain the Refuge's prescribed fire

objectives. In addition, the Refuge may provide sites for numerous, long-term ecological and wildlife studies. Research at the Refuge may result in information that will help fish and wildlife managers better protect, conserve, and enhance wildlife and their habitats.

C. Fire Management Organization and Responsibilities

Prime Hook NWR fire management organization includes: Project Leader, Refuge Biologist, Regional Fire Management Coordinator, District Fire Management Officer, and Collateral Duty Firefighters. Fire assignments are made on the basis of individual qualifications and position requirements. A listing of current fire management staff and qualifications is found in Appendix D.

1. Project Leader

- Responsible for the overall management of the refuge including the fire program.
- Ensures that Department, Service, and refuge policies are maintained and followed.
- Ensures sufficient collateral duty firefighters meeting Service standards are available for initial attack.
- Supervises the resource management activities of the refuge, including the selection of objectives and tools to be used in achieving objectives (including prescribed fire).
- Works with Refuge Biologists in developing objectives and tools to achieve them including prescribed fire.
- Reviews and approves prescribed burn plans for Prime Hook NWR.

2. Regional Fire Management Coordinator (RFMC)

- Responsible for oversight of the fire program and coordinates budget preparation and fire activities.
- Reviews Fire Management Plans and Annual Prescribed Burn Plans.

3. Fire Management Officer (FMO) located at Great Dismal Swamp

- Maintains liaison with Regional Fire Management Coordinator and Cooperators.
- Manages district prescribed fire activities including:
 - Coordinates annual prescribed fire program to meet management objectives
 - Prepares or approves individual prescribed fire plans
 - Serves as or designates Prescribed Fire Burn Boss
 - Provides daily validation that prescribed fires are under prescription and meet all other Service policy requirements
- Assists Refuge Biologists with fire research and fire effects monitoring.
- Assists in the operation of the fire public relations program:
 - Responsible, with the Public Use Staff, for planning programs to educate the public regarding the role of fire in the Refuge and fire prevention
 - Prepares and presents slide programs, video presentations and displays about the Fire Management Program
- Coordinates and supervises the fire management program.
- Prepares and manages the fire budget.

- Administers the payroll, purchasing and travel for the fire staff.
- Supervises the fire staff.
- Plans, coordinates, and directs all Preparedness activities including:
 - Fire training
 - Physical fitness testing and Interagency Fire Qualification System and data entry.
 - Fire weather station operation and data entry.
 - Fire cache and equipment inventory accountability, maintenance and operation.
 - Coordinates with cooperative agencies. Revises agreements as necessary.
 - National Fire Danger Rating System (NFDRS) use.
 - Insures the step-up Preparedness plan is followed.
 - Prepares annual Fire Base budget request, tracks use of funding.
 - Informs staff of fire situation and potential for wildfire
- Coordinates and directs all suppression activities including:
 - Dispatching
 - Fire Command
 - Insures fire management and safety policies are observed
 - Advising Refuge Manager of the status of fire suppression operations
- Prepares a fire prevention plan, and coordinates fire prevention duties with other employees.
- Coordinates refuge fire training needs.
- Annually updates the Fire Management Operations Plan, maintains fire records, and reviews completed DI-1202's for accuracy.
- Administers the suppression evaluation process on wildland fires.

4. Collateral Duty Firefighters

- Maintain assigned fire equipment in ready state.
- Complete yearly refresher training and fitness testing to maintain readiness.

D. Interagency Operations

Refuge fire management programs will consider the impact on other interagency and state programs plus local resources, and coordinate common policies, prescriptions and management responses to fire occurrences when managing fires that cross Refuge boundaries. Refuge staff will work with state and local departments, potentially affected communities, and neighboring individuals to prevent unauthorized and careless ignition of wildland fires. The refuge is a partner in wildfire/urban interface areas, providing assistance to wildland firefighting in the form of personnel, equipment, or technical advice.

The refuge currently has a very small number of qualified individuals and a minimum base of equipment for suppression activities, depending heavily on other agencies for suppression resources. Portions of the refuge are located within the jurisdictions of 2 volunteer companies, the Milton Fire Department and the Memorial Fire Department of Slaughter Beach. The refuge has longstanding cooperative agreements for suppression of wildland fires with both companies. These

companies are dispatched by the Sussex County Fire Call Board for all fire incidents within their fire district. The local fire chief has authority to call in additional resources and or equipment as needed. The Delaware Department of Agriculture's Forest Service may also be called upon for any fire incident by local departments or refuge personnel. The refuge maintains a cooperative agreement with the Delaware Forest Service which includes both suppression of wildland fires and assistance in conducting prescribed burning activities.

Additional fire suppression resources within two hours of the Refuge include personnel and equipment from Eastern Neck, Bombay Hook and Blackwater NWRs. See Appendix E. for current cooperative agreements and listing of contacts and cooperators.

The Dispatch Plan (Appendix F.) contains the guidelines for a reported fire and the proper dispatching to effect a quick and orderly initial attack by the closest local resource.

E. Fire Management Strategies

The following strategies will be employed to meet the fire management objectives:

- Suppress all wildland fires in a safe and cost effective manner consistent with resources and values at risk.
- Minimum impact strategies and tactics will be used when possible.
- Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations.
- Maintain an Initial Attack organization capable of suppressing wildland fires. Initial Attack equipment and personnel shall be distributed to maintain a minimum response time of one hour during the fire season.
- Maintain Memorandums of Understanding with local fire agencies and protection districts to promote cooperative prevention, suppression, and prescribed fire activities. Provide assistance to local or federal cooperators under the "closest resources" principles in accordance with Service policy.
- Prepare and implement an effective fire prevention plan to minimize fires, particularly fires occurring outside the fire season when adequate suppression resources may not be available.
- Utilize prescribed fire as a management treatment for achieving hazardous fuel reduction and resource management objectives.
- Initiate cost effective fire monitoring which will tell managers if objectives are being met. Monitoring information also will be used to refine burn prescriptions to better achieve objectives.
- Integrate fire ecology, management, and prevention themes into existing interpretive and education programs.
- Within designated sensitive habitats follow national policy to limit suppression tactics that will have long-term unnatural environmental effects. This includes limiting the use of retardant or heavy equipment to life-threatening situations without the specific approval of the Project Leader.

General Constraints

Selected methods should cause minimum resource damage while accomplishing effective incident stabilization. Incident Commander should not use heavy equipment off designated roadways without specific authorization of the Project Leader or a designated representative. The safety and property of private citizens and incident personnel are paramount concerns. Suppression methods that impact fragile habitats should be weighed carefully against the need to protect property within and adjacent to the Refuge, provided there is minimal threat to human life.

Fire inhibiting chemicals such as aerially applied retardants and Class A foam solutions should be used only with the concurrence of the Project Leader. Direct application of these chemicals into waterways such as impoundments, inflows, stream channels, or drainage ditches must be avoided. Guidelines implemented in June 2000 require the application of retardants and class A foams be avoided within a 300 foot buffer zone of wetland habitats.

Wildfire size-up should include an assessment of the threat to state and federally-listed endangered, threatened, and special concern species and their habitats from the fire and suppression measures. Similarly, wildfire size-up requires an assessment of the threat to cultural resources from the fire itself or suppression measures. Should either situation occur, advice will be sought from the Refuge Biologist or the State Historic Preservation Officer.

Roads, ditches, canals, streams, or impoundments will be used as firelines whenever possible. When constructed firelines are necessary, buffer strips of 30.5 m (100 feet) will be maintained between waterways and fisheries. When firelines must be placed within 30 m of waterways, they will be oriented perpendicular to the waterway, if practicable. Use of heavy equipment and application of chemical fire retardant will be avoided within the strip.

II. Refuge and Fire Environment Descriptions

A. Refuge Description-Prime Hook National Wildlife Refuge

Prime Hook NWR is located along the southwestern shore of Delaware Bay in rural Sussex County, in Milton, Delaware. See Appendix G. for a general location map. Stretched along the eastern coastline of Delaware, just north of Cape Henlopen, the refuge is characterized by tidal stream and fresh water creek drainages terminating in the Delaware Bay, associated coastal marshes, and dispersed forested and upland areas. The refuge was established under the authority of the Migratory Bird Conservation Act in 1962 for use as an inviolate sanctuary, or any other management purpose, expressly for migratory birds. The refuge is located in a key position in the Atlantic flyway and each year, hosts hundreds of thousands of migratory birds. Today the Refuge's primary objectives continue to focus on providing habitat and protection for waterfowl, waterbirds and other migratory birds, and endangered species; and to insure the availability of these resources to the American people for their enjoyment now and in the future.

The refuge is located within two hours driving time of metropolitan Baltimore, MD, Washington D.C., Wilmington, DE and Philadelphia, PA. The refuge is about 22 miles southeast of the state capital of Dover; (population 32,500) and 12 miles north of the resort communities of Lewes, Rehoboth Beach, and Dewey Beach. Historically, the surrounding area has been primarily dominated by agricultural lands. Corn, soybeans, and wheat are the principal cash crops. However, during the 1980's and 1990's, extensive beach development began to become a significant land use, including vacation homes, retirement communities, golf courses, and shopping malls. The eastern boundary of the refuge is adjacent to three beachfront communities: Slaughter Beach, Prime Hook Beach, and Broadkill Beach. Appendix H. contains a map with current refuge boundaries.

The topography is very flat with almost all of the refuge lying below the 10 foot mean sea level contour. Extensive fresh and brackish wetlands, and salt marshes border much of the refuge uplands. The refuge currently comprises about 10,000 acres, of which approximately 75% are wetlands. Agricultural land, forest, scrub/shrub lands and grassland make up the rest of the refuge.

B. Fire Environment and History

1. Fire Season, Occurrence, and History

Presettlement

Identifying fire frequencies for presettlement vegetation types can be used to mimic historic fire intervals, to plan prescribed fire activities, and delineate fire management strategies (Frost 1998). Understanding the pervasive role of fire in shaping natural vegetation is necessary, in order to maintain, restore, and manage viable ecological systems, including fire dependent species.

A combination of fire types, including naturally-occurring (lightning-caused) fires, and fires

associated with the activities of Native Americans and European colonists have historically influenced vegetation in the eastern United States (Patterson and Sassman 1988). Brush (1986) found evidence that fires occurred in the Delmarva region between 1000 and 1200 A.D., and more recently, Kirwan and Shugart (2000) found charcoal evidence of historic fires in Delmarva forests, especially forests containing scarlet oak (*Quercus coccinea*).

Fire historically influenced habitats in the mid-Atlantic (Frost 1998) including areas of the Coastal Plain (Komarek 1968). Frost (1998) estimates that fire frequency in coastal Delaware prior to European colonization was every 7-12 years.

Post-Settlement Fire History

Sussex County Delaware was first settled by the Swedish in the 1600s. European settlers practiced large-scale farming and used fire to sustain hunting and trapping, enrich forage of pastures for domestic animals, and for slash-and-burn agriculture (Pyne et al 1996).

From the late 1800s, until its establishment, refuge marsh and upland habitats were burned by frequently occurring low-intensity fires. Marshes and adjacent uplands were burned each spring by landowners to prevent encroachment of scrub-brush vegetation and red cedars. Fire was used to improve habitat for grazing and haying for cattle in salt marsh areas and maintain the neat appearance of the landscape. Because local marsh habitats were annually burned, heavily grazed and harvested, large fires were virtually non-existent during this period. An occasional small fire was ignited by upland game hunters to "smoke out" their prey. Local trappers also burned the freshwater marshes annually at the end of each season to improve habitat conditions for muskrats and facilitate trapping endeavors.

Refuge Wildland Fire History and Prescribed Fire Use

From the 1970s until the early 1980s, common reed, (*Phragmites australis*) dominated refuge marshes. Wildfires were easily caused by human carelessness and arson. There are a few notable fires. On January 13 and 14, 1969 an arson ignition near Prime Hook Beach Road resulted in an unwanted fire that burned over 1,500 acres of marsh and endangered the Prime Hook Beach and Broadkill Beach communities. On April 17, 1977, a fire of undetermined origin, fueled by *Phragmites*, burned 1,100 acres along Prime Hook Beach community. The houses abutting this portion of the marsh were threatened. The fire burned for three days with over 200 volunteers from eight fire departments, the Lewes Naval Facility, Delaware Forest Service and the Delaware State Police battling the fire. In November of 1985, arson burned 960 acres of *Phragmites* endangering the homes in Prime Hook Beach. For a comprehensive summary of Refuge Fire History see Appendix I.

During the 1980s, the refuge used prescribed fire to reduce hazardous accumulations of *Phragmites* and woody fuels. Fire was also used in woodland habitats to improve understory conditions for the Delmarva Peninsula Fox Squirrel, more diverse plant communities and increase oak recruitment. The last prescribed burn occurred in 1988.

2. Climate

The weather conditions year round are generally mild, with temperatures ranging from 32°F for an average low and about 80°F for an average high. Extremes may dip below 10°F during February or above 100°F in July. Normally, summer ocean breezes keep the coastal areas cooler than inland areas, and on most winter days, the bay and ocean help attenuate colder temperatures.

Yearly and seasonal precipitation are highly variable during a 270-day growing season. Annual rainfall totals average around 42 inches. Snowfall is usually light, average 14 to 18 inches per year. Lightning occurs during the late spring and summer months and lightning strikes average 2 to 5 per season and are usually accompanied by wet storms. Occasional hurricanes occur seasonally from late August to October 1. Northeaster storms hit from November through the end of March. High tides and strong sustained northeast winds from strong Northeasters can lead to flooding of Delaware Bay waters into the impoundments, causing heavy erosion of Refuge dikes and extreme salt water intrusion of impoundments and some upland habitats.

Table 1. Monthly Average Total Precipitation as Recorded at the Delaware Cooperative Extension Georgetown, DE

Month	Average Precipitation (inches)
January	3.9
February	3.02
March	4.58
April	3.46
May	3.84
June	3.09
July	3.58
August	5.22
September	3.49
October	3.42
November	3.56
December	3.18
Total	44.34

3. Habitat Types

a. Wetland Habitats

Wetland habitats represent about 80% of Prime Hook's total acreage. The four major habitat types of wetland classes at Prime Hook NWR are aquatic bed, emergent marsh, scrub/shrub and forested wetlands (Cowardin et al 1979).

Aquatic Beds- 456 acres/5 %

Shallow water habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. The water regime is seasonally flooded.

Aquatic beds represent a diverse group of plant communities that require surface water for growth and reproduction and are either attached to the substrate or floating freely in the water. Dominant species include white water lily (*Nymphaea odorata*), yellow cow-lily (*Nuphar luteum*), coontails (*Ceratophyllum sp.*), water milfoil (*Myriophyllum sp.*), pondweeds (*Potamogeton sp.*), widgeon grass (*Ruppia maritima*), water shield (*Brasenia schreberi*), smartweeds (*Polygonum sp.*), duckweeds (*Lemna sp.*). *Hydrilla verticillata* has invaded aquatic beds where public fishing and boat access is heavy.

Emergent Wetlands- 6,194 acres/60%

Vegetation that is characterized by erect, rooted, herbaceous plants that are present for most of the growing season. The refuge contains species that tolerate a wide range of salinity and flooding, including Saltmarsh cordgrasses (*Spartina spp.*), needlerush (*Juncus gerardi*), saltgrass, (*Distichlis spicata*), pickleweed (*Salicornia virginica*), common reed, (*Phragmites australis*), cattails (*Typha spp.*), bulrushes (*Scirpus spp.*), sedges (*Carex spp.*), waterdock (*Rumex spp.*), rose mallow (*Hibiscus palustris*), rice cutgrass (*Leersia oryzoides*), Chufa (*Cyperus esculentus*), beggarticks (*Bidens spp.*), Walter's millet (*Echinochloa walteri*), smartweeds (*Polygonum spp.*), wild rice (*Zizania aquatica*), Fall panicum (*Panicum dichotomiflorum*), arrow arum (*Peltandra virginica*), pickerelweed (*Pontedaria cordata*), and arrowheads (*Sagittaria sp.*).

Scrub-Shrub Wetlands- 688 acres/7 %

These habitats are dominated by woody vegetation less than 6 meters tall. They represent a successional stage leading to forested wetlands. In estuarine influenced areas, they are dominated by groundselbush (*Baccharis halimifolia*), marsh elder (*Iva frutescens*), bayberry (*Myrica pennsylvanica*), and red cedars (*Juniperus virginiana*). Palustrine influenced areas are typified by buttonbush (*Cephalanthus occidentalis*), seaside alder (*Alnus maritima*), Atlantic white cedars (*Chamaecyparis thyoides*) and red maples (*Acer rubrum*).

Forested Wetlands- 772 acres/ 8 %

Characterized by woody vegetation that is 6 meters tall or taller. All water regimes are included except subtidal. Dominant trees typical on the refuge include red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), tupelo gum (*Nyssa aquatica*), swamp white oak (*Quercus bicolor*), and Atlantic white cedar (*Chamaecyparis thyoides*). A composite of loblolly-hardwood mix, where loblolly pine (*Pinus taeda*) is not dominant but comprises 20 % or less of the stocking mixture with hardwoods

tolerant of wet sites, is also present in some forested wetland areas.

b. Upland Habitats

Upland cover classifications and acreage determinations from GIS mapping of the refuge include Anderson's Level II Classification System and the SAF Forest Classification (Eyre 1980). Upland habitats cover approximately 20% of the Refuge's total acreage.

Agricultural Lands-1,013 acres/11 %

The refuge currently has about 400 acres in a traditional cooperative farming program. The remaining lands are maintained as grasslands or old fields.

Deciduous Forest- 517 acres/ 6 %

Hardwood - loblolly pine mixed stands where loblolly is not dominant (20% or less) is the predominant association found on refuge. Moist to wet sites typical of refuge coastal areas are dominated by sweetbay (*Magnolia virginiana*), swamp tupelo (*Nyssa aquatica*), and red maple (*Acer rubrum*). In more inland wet areas, hardwood components are sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*) and red maple (*Acer rubrum*). On upland and drier sites component hardwoods are southern red oak (*Quercus falcata*), white oak (*Quercus alba*), hickory (*Carya spp.*) and blackgum (*Nyssa sylvatica*). Most of the deciduous forest is found along fields and marsh edges or small wooded islands.

The second most common type on refuge deciduous forested areas is the sweetgum association. On well drained sites Virginia pine (*Pinus virginia*), hickory (*Carya spp.*), sassafras (*Sassafras albidum*), and persimmon (*Doispyros virginiana*) are frequently found. On sites moderately to poorly drained red maple (*Acer rubrum*), blackgum (*Nyssa sylvatica*), willow oak, and yellow-poplar (*Liriodendron tulipifera*) are common.

Evergreen Forest Land - 104 acres/1 %

Loblolly pines (*Pinus taeda*) and eastern red cedar (*Juniperous virginiana*) dominate refuge evergreen areas.

Deciduous shrubland - 48 acres/ < 1 % of Refuge Cover

Refuge brushlands are typically former cropland or pasture lands cleared from original forest in the late 1800s and early 1900s which now have grown up in brush in transition back to forest land. The predominant species are groundselbush (*Baccharis halimifolia*), high tide bush (*Iva frutescens*) and bayberry (*Myrica pennsylvanica*).

Grasslands- 154 acres/1 %

The predominant endemic grassland species is switchgrass (*Panicum virgatum*).

4. Fire Effects

a. Vegetation and Fuels

Grasslands/Shrublands

Fire can restore early successional habitats, by increasing grass cover and reducing cover of tall forbs (Herkert 1994, Jones and Vickery 1997), remineralizing litter (Anderson 1990); increasing grass productivity (Anderson 1990, Knapp et al. 1998), retarding woody plant invasion (Anderson 1997), and increasing community diversity (Howe 1995). Prescribed fire also may be used to maintain an interspersed of shrub- and grass-dominated communities attractive to mid-successional, shrubland passerines.

Upland Forests

Fire is a natural disturbance that has shaped forest habitats in parts of the eastern U.S. for thousands of years. Anthropogenic fire exclusion has impacted native eastern habitats, especially forests, including diminished oak regeneration and the build-up of fuels to levels conducive to intense wildfires. In many cases, prescribed fire can address such issues by increasing oak recruitment and reducing threats of catastrophic wildfires through hazard fuel reduction.

Wetlands

Fire is a natural, cyclic process in many wetland systems, and may be used, on a rotational basis, to enhance productivity of some marsh plants; increase waterfowl foods such as certain invertebrates and seeds; and remineralize accumulated litter. Fire may be used to open dense stands of vegetation, such as cattails, or as a component in a *Phragmites* control program. The refuge will consider historic marsh fire regimes, the phenological cycle of native marsh plants, and the life cycle needs of marsh wildlife, when developing burn prescriptions for wetlands habitats.

b. Wildlife

The direct impacts of fire on wildlife generally include disturbance or infrequent mortality of individuals or groups of individuals, particularly slow moving and/or sedentary species. Most ecosystems in the eastern U.S. evolved with fire as a natural disturbance, with various return frequencies according to site. Most species have evolved responses and adaptations to fire; some cannot be maintained in a region without fire's periodic influence (DeBano et al. 1998). A variety of successional stages can be maintained with prescribed fires, contributing to overall habitat diversity across the Refuge landscape. Fire may also be used to assure that particular, fire-tolerant or fire-adapted species and communities are maintained, further contributing to species diversity. In general, catastrophic, stand-replacing fires cause significant, but often short-term adverse impacts on large areas of wildlife habitat. Such sites eventually revegetate and repopulate, through secondary successional processes.

It is important to consider the life cycles of plants and other species, and the fire regimes to which they are adapted, when assessing the effectiveness of fire in wildlife management. Prescriptions for prescribed fire should take into account the following factors: 1) fire frequency, 2) season of fire, and 3) severity, duration, and extent of burning (DeBano et al. 1998). Each of these aspects of fire

behavior can have specific consequences for a plant or animal species. For example, a plant or insect species may be eliminated from a site if fire occurs too often, or during the wrong part of the organism's life cycle.

c. Soils

Fire elevates surface temperatures; mineralizes detritus, litter and standing dead material; volatilizes some nutrients and organic matter; alters soil water-holding capacity; and alters populations of soil micro- and macro-fauna (Barbour et al. 1999). In general, prolonged adverse impacts to soil are minimal. Most wildland fires and prescribed fires are rapid, and of low to moderate intensity, consuming only part of the duff/litter layer and rarely transferring significant amounts of heat into the soil. Prescribed fires will be used to remove litter and light fuels, and prevent the effects of severe, hot, wildfires on soil resources.

Organic matter – effects depend upon intensity and duration of fire. Intense, long-duration fires consume more organic matter than brief, low-intensity fires. Nitrogen compounds volatilize and are lost at temperatures of 100-200 °C; in contrast, Calcium, Sodium, and Magnesium are usually deposited on the soil surface and recycled. At temperatures of 200-300 °C, large amounts of organic substances are lost, which can reduce the cation exchange and moisture-holding capacity of soils.

Chemical reactions - fire usually elevates soil pH as a result of cation release; the effect is particularly evident on acidic soils. In coastal plain regions, there is often an increase in soil potassium and phosphorous levels following forest fires. Soil microbial nitrogen fixation may be enhanced following fire, due to the mineralization of nutrients and elevated pH levels in soils (Barbour et al. 1999).

Physical Effects - removal of litter and duff may initially facilitate water infiltration; nevertheless, evaporation is also mediated by loss of litter and blackened soils. This results in an overall reduction in the water-holding capacity of soils. There is little change in water repellency with cool fires (below 176°C); moderately hot fires increase water repellency (176-204°C). Extremely hot fires (above 204°C) volatilize hydrophobic substances and destroy soil water repellency (Debano et al. 1998b). After moderately intense fires, runoff may be increased, due to lowered infiltration, and erosion may result.

Soil Biota - fires usually reduce fungi, but increase soil bacteria and actinomycetes populations. Fire may remove soil and litter pathogens. Nitrifying bacteria are often destroyed by fire. Legumes and other nitrogen-fixing plants often must recover nitrogen losses due to volatilization, as the recovery of nitrifying bacteria is slow (Barbour et al. 1999).

d. Air Quality

The effects of fire on air quality vary depending on time of year, fuel loading, and location of the

unit. Air quality effects are normally minimal except with the most severe and intense wildfires. Intense wildfires often are accompanied by visual impairment and compromised air quality during the duration of the incident. Adverse air quality associated with prescribed burning usually is minimal since burn units are small and only ignited under conditions that yield adequate smoke dispersal and total consumption of fuels less than 2.5 cm (1.0 in) diameter. Larger fuels, such as stumps, snags, and logs are usually unavailable (higher moisture content) or easily extinguished during mop-up operations.

The goals of smoke management on the Refuge will follow goals enumerated by the National Wildfire Coordinating Group (1985): reduce fire emissions, enhance the dispersal of smoke plumes, and steer smoke plumes away from smoke-sensitive areas. Smoke management practices will include maximizing combustion efficiency to reduce particulate emissions.

5. Threatened and Endangered Species

The Delmarva Peninsula Fox squirrel is the only federally endangered species known to occur on the refuge. The refuge also contains state listed species, including rare bog plant species.

The Refuge Fire Management program will be implemented in cooperation with the Endangered Species Act of 1973, as amended, and will take appropriate action to identify and protect from adverse effects any rare, threatened, or endangered species. Service policy requires that State threatened and endangered species and Federal candidate species will be incorporated into any planning activities.

The Delmarva fox squirrel and the state-listed plant species inhabiting bogs occupy open-canopy habitats that may benefit from periodic disturbance, such as fire, to set back woody succession. Such actions will require planning and consultation with endangered species habitat specialists to ensure that fire treatments are compatible with life cycle requirements of listed species.

6. Wildlife Resources

Prime Hook NWR provides habitat for hundreds of species of birds, several species of mammals, reptiles, amphibians and fishes. Two hundred and sixty-nine bird species have been identified using the refuge since its establishment, and 115 of these nest on or near the refuge. The fall migration from early October until Christmas is when peak numbers of birds utilize the refuge, as many as 85,000 ducks and 159,000 geese have been recorded during a single aerial survey census. During late April and May significant numbers of spring migrating shorebirds use the Refuge's impoundments and again during the fall migration from mid-July through September. Neotropical landbirds migrate through and utilize the Refuge's forested, scrub/brush and grassland habitats during both spring and fall migrations. Over 40 species of mammals are known to reside on the refuge. The diversity of habitat types are also home to 34 species of reptiles and amphibians which include 9 species of snake, 8 species of turtles, 2 lizard species, 3 salamanders, and 12 toad and frog species.

Turtle, Fleetwood, Goose and Flaxhole ponds along with the seven mile long Prime Hook Creek and auxiliary drainage ditches support over 40 species of fin fish and 2 species of shellfish. See Appendix J. for a complete listing of wildlife species known to occur on refuge.

7. Topography and Soils

Prime Hook NWR has a flat terrain typical of Atlantic Coastal areas. The highest point within the refuge is about 15 feet mean sea level but the vast majority of refuge lands lie below the 10 foot contour. The uplands are gently sloping with very few steep grades -- mostly limited areas immediately adjacent to drainage courses. Two soil associations are found on refuge: Tidal-Marsh-Salty and Sassafras - Fallsington. Tidal marsh soils are low-lying soils that are regularly flooded with either fresh or salt water. These soils are mostly peat or muck remains of vegetation, but include loamy soil materials. These soils range from strongly saline (30 - 50 ppt) to brackish (0 - 20 ppt) or almost fresh (0 - 5 ppt) depending on annual water-regime influences.

The water table is at or near the surface for long periods of the year. Sassafras soils are well drained to poorly drained soils that have a moderately permeable subsoil of sandy loam to sandy clay loam. In most refuge areas they are nearly level to very gently sloping. These soils range from moderately permeable to well drained. Fallsington soils have a surface layer of gray to dark grayish-brown sandy loam or loam and a subsoil of gray to light gray heavy sandy loam to sandy clay. These soils are all nearly level, moderately permeable and poorly drained.

8. Water Resources

Prime Hook NWR is comprised of almost 8,000 acres of marsh, open water, small creeks, and impoundments. The primary sources of fresh water are direct precipitation, run-off from surrounding agricultural lands, and the ponds and creeks that flow into the Refuge's three main drainage courses. It also receives water to a much lesser extent from ground water recharge.

Tides from the Delaware Bay also influence refuge lands. The normal tidal range of the Delaware Bay Water Basin is between 12 and 26 inches. During normal tidal situations, salt water inundation of these marshes is minimal. However, during extreme tidal events and Northeaster storm surges, higher tides overtop roads, dunes, and dikes inundating the marsh areas. This process is repeated several times each year and as a result, the great annual salinity variations affect the general ecology. Periodic salt intrusion causes halophytes to exist in certain lower areas which out-compete other plant species that are less salt tolerant. The 4500 acres of impounded marshes are considered to be fresh to moderately brackish, yet the vegetation in many cases is climax or near climax salt marsh.

9. Social/Political/ Economic Concerns

Delaware is the second smallest state by area of the fifty states. Three-fourths of all Delawareans live in cities, or large urban areas. Wilmington (pop 100,000) is Delaware's largest urban area.

The state capitol, Dover (35,000) ranks as the 2nd largest city. The refuge is located in Milton, Delaware. Milton is a small (2,300) community of coastal Sussex County. Founded and incorporated in 1807, Milton is located at the head waters of the Broadkill River and boasts 198 homes on the National Historic Register with many examples of 18th and 19th century architecture.

Sussex County is one of the one of the fastest growing counties on the East Coast. (Economic Development Office- Sussex County Profile 2001) The county's leading industry today is agriculture. Broiler chickens are Sussex County's top farm product. Dairy farms in Delaware produce \$18 million worth of milk each year. Soybeans and corn are ranked 3rd and 4th in importance. The Delaware Bay and Atlantic Ocean traditionally provide incomes to Sussex County. Each year fishing industry workers catch more than \$6 million worth of fish and shellfish and the blue crab harvest generates about \$5 million. Delaware's forest-based industry provides jobs for 3,700 individuals with total annual wages estimated at \$ 98 million. (ELI 1999)

Tourism is Sussex County's second-largest industry and growing every year. Sussex County is close to the nation's largest metropolitan area. A recent research survey reported that 2.3 million visitors visited the area, with 94% targeting Sussex County as their final destination. These visitors contributed \$342 million to the southern Delaware economy (Delaware Economic Development Office 1998) .

Outdoor recreation is an increasing source of revenue to Sussex county. According to a 1996 survey, 232,000 Delawareans engage in fishing, hunting or wildlife watching activities annually (USFWS). The percent of state residents participating in wildlife recreation categorized by activity included 83% - wildlife watching, 47% - fishing, and 14% - hunting. Summary statistics revealed 40,000 hunters and 196,000 anglers using Delaware lands and waters spent \$444 million on hunting and fishing trip related expenses. Wildlife watching activities generated \$64 million.

11. Cultural Resources

Based on a cultural resource assessment in the early 1980's, six prehistoric sites and four "find spots" have been designated and registered within the boundaries of the refuge (Tirpak & Thomas 1981). Artifacts from early Native American groups have been collected from these sites and have been registered and stored with the state's Bureau of Archaeology and Historic Preservation. Since these heritage resources have been identified, heritage resource management activities on Refuge will ensure that these sites and materials are protected from any prescribed fire and/or fire suppression actions.

A cultural resources survey was conducted at the Refuge by Mid-Atlantic Archaeological Research, Inc. in 1980. As a result of field investigations, six new prehistoric artifact concentrations, four prehistoric "find spots", and three historic artifact resource areas were identified. The six prehistoric sites ranged from Late Archaic to Late Woodland in cultural affiliation. Two were per-glacial pingo-like remnants, three were in upland areas, and one was located on an island. The three historic sites consisted of scatters around two pingos and the

documented ruins of the Morris family residence. Artifacts found at the historic sites ranged from the 18th through the middle 20th century. (Tirpak & Thomas 1981)

The survey shows that a much heavier occupation of the coastal region occurred during the past several thousand years than was previously modeled. The discovery of prehistoric cultural resources within narrow-necked upland areas and on fast land marsh islands suggests that similar sites will be found if all such loci are intensively investigated.

Three of the historic sites had enough artifacts associated with them that make them eligible for inclusion in the National Register of Historic Places. The first of these is the historic component of the old Morris residence located in the headquarters area. The second significant resource site with further research potential is located on Teacup Island. This site contained shell midden artifacts and preserved organic debris. The third cultural resource is the Oak Island site. This site contained thick aboriginal ceramic sherds of a type not adequately studied in coastal Sussex County. These sherds may reflect the utilization of Oak Island by earlier peoples during periods when the marshland environment was unlike that of today. Appendix K. contains a complete map of historic and cultural sites on the refuge.

12. Land Use, Values, and Improvements

The refuge is home to a number of valuable structures which should be protected. The refuge headquarters area contains a 1\$ million office and visitor center, a trailer housing refuge staff and regional biologists, and a small building housing the regional biologist. Natural fire breaks such as roads and ditches already protect these improvements. A complete listing of refuge improvements, their value and location can be found in Appendix L.

III. Wildland Fire Program

A. Preparedness

1. Fire Season

Delaware's wildland fire season in Sussex County is generally from March through mid-May and then again from mid-September to mid-November, when precipitation is reduced, relative humidities are lower, winds are higher and fuels are cured. During dry summers, grassland and brush wildfires are more prevalent, often occurring from discarded cigarettes, accidental escape of debris burns on private lands, and/or arson.

Monthly rainfall averages are lowest during April, May, September, and November. During early spring, snow cover is uncommon, fine fuels are cured and gusty southwest winds prevail. Fires occurring in the spring are normally fast spreading, short-lived, and confined to surface fuels, while fall fires are more preponderant in cured brush and forested vegetation. Most of these fires are also surface burning in nature and occasionally lightning fires do strike more mature trees but spreading is minimal as most mature stands are highly fragmented.

a. Potential Fire Behavior

Control problems may be a problem on fires burning in the peak fire season (Winter/Spring and Fall). When continuous fuels and warm, dry, windy environmental conditions are encountered, high fire intensities and rapid spread rates can be achieved within a short time especially in fuel model 3 (tall grasslands or marshes). In these situations, firefighter safety may dictate use of indirect attack suppression methods. Many areas within the Refuge are confined by natural boundaries such as creeks and roads. Suppression activities in these areas could utilize these natural and manmade boundaries if no structural impact is expected.

Each of the Fire Management Units (FMUs) on the Refuge contain several fuel types. The following fuel types are found throughout the Refuge.

Fire Behavior Fuel Model 1 (National Fire Danger Rating System [NFDRS] Model L)

This model represents grassland fields found within all refuge FMUs. These fields are characterized by short and medium cool season grasses with some broadleaf herbaceous vegetation and few encroaching woody plants. Fuel loading is generally under 2.0 ton/acre. Fields which fall under this model are mowed periodically. Thus, the fuel bed is under 0.6m (2.0 ft) for much of the year.

Fire spread is governed by the fine and continuous herbaceous fuels that have been completely or partially cured. Surface fires that move rapidly through the cured vegetation are typical. Fires occurring within fuel model 1 are typically a problem at Prime Hook NWR in spring and occasionally in fall when perennial grasses are cured. High spread rates can be expected, but fire intensities remain low and are short in duration. Flame lengths may approach 1.2 m (4.0 ft).

Significant wind events may yield a rate of spread greater than 50 chain/hr. A fire in this fuel type will usually do little permanent damage to resources.

Fire Behavior Fuel Model 3 (NFDRS Model N)

The vegetation which characterizes this fuel model includes emergent wetland plants (e.g. *Spartina* and *Phragmites*) and tall grasses (e.g., switchgrass, big bluestem, and reed canary grass). This fuel type typically exceeds 0.9 m (3.0 ft) in height and the total fuel loading present exceeds 3.0 ton/acre.

Fires in this fuel model are the most intense of the grass group and display high rates of spread under the influence of wind. Wind may drive fire into the upper heights of the vegetation and across standing water. Windy spring or fall days with high temperature and low relative humidity make this fuel type hazardous. An extremely fast moving fire front exceeding 100 chain/hr with flame lengths greater than 3.7 m (12.0 ft) can be expected. A fire in this fuel type will normally be controlled only at the change in fuel type near the edge of the marsh or the fire break.

Fire Behavior Fuel Model 5 (NFDRS Model F or T)

This fuel type consists of understory grasses and forbs, and litter cast by shrubs. The shrubs are young with little dead material and the foliage contains little volatile material. Thus, fire intensity is generally low.

Slow-burning fires are expected with rates of spread less than 5 chain/hr and flame lengths under 0.6 m (2.0 ft). Fire is ordinarily carried in the surface fuel.

Fire Behavior Fuel Model 8 (NFDRS Model H and R)

Fuel model 8 consists of mainly deciduous woodlands with closed to semi-closed canopies. The litter layer is compact, composed of leaves and twigs, and has little undergrowth.

Slow-burning surface fire can generally be expected with low rates of spread (< 5 chain/hr) and flame lengths less than 0.6 m (2.0 ft), except when an occasional fuel concentration is encountered. Fires will normally remain on the surface, except under dry conditions when fire may burn down through the duff layer and into underlying peat deposits. Only under severe weather conditions that involve high temperature, low relative humidity, and high wind speed do these fuels pose fire hazards. Occasional flare-ups are possible when fire encounters larger fuel concentrations.

Fire Behavior Fuel Model 9 (NFDRS Model E)

Model 9 consists of open or closed deciduous stands and mixed stands during leaf-off, otherwise similar to fuel model 8. The litter layer is fluffy and leaves are subject to movement under windy conditions. Scattered concentrations of dead or downed woody material are greater than in Fuel Model 8.

Fires in this fuel type will have a higher rate of spread due to the deciduous leaf litter layer. Under windy conditions, expect spotting problems from rolling and blowing leaves. Fires will generally

remain on the surface and can be problematic in spring before green-up. This fuel type can also be problematic in fall if precipitation is below normal and an unwanted ignition source is present. Flame lengths may exceed 0.6 m (2.0 ft) with a rate of spread of 5 to 10 chain/hr. Containment problems can be expected under windy conditions.

b. National Fire Danger Rating System Values for Fuel Models

Potential fire behavior by fuel models found at Prime Hook were previously discussed above under, *a. potential fire behavior*. Records for fire occurrence indicate many of the fires to be human caused from debris burning, arson or discarded cigarettes .

Wildland fire may start near refuge boundary lines or where public access is permitted. Fire Behavior Fuel Model 1 or 3 is the most probable starting fuel model with the highest rates of spread. Fire intensities may remain low and of short duration in fuel model 1, with flame lengths approaching 1.2m (4.0 ft). Keeping fire out of more flammable fuel models, such as fuel model 3, coarse marsh grasses, reduces the wildland fire threat.

Table 2. Index break point by Fuel Model (FM) present on Prime Hook NWR.

INDEX	FM L		FM N ⊗		FM R		FM E		FMF	
	90	97	90	97	90	97	90	97	90	97
IC	18	29	26	34	22	34	19	27	31	43
SC	49	87	75	107	2	4	7	10	15	42
ERC	2	3	28	32	13	16	17	19	19	30
BI	25	39	97	111	15	19	25	31	35	77
KBDI	428	493	428	493	428	493	428	493	428	493

where: IC = Ignition Component
 SC = Spread Component
 ERC = Energy Release Component
 BI = Burning Index
 KBDI = Keetch-Byram Drought Index

⊗Primary Fuel Model for day to day tracking and Step-up planning actions.

Fuel Model Key

L Open Grass Field, generally under three feet in height
 N ⊗ **Marsh, coarse grass habitat, less than 25% woody shrub component**
 R Deciduous Forest Leaf Litter, summer months

E Deciduous Forest Leaf Litter, spring and fall
T Woody shrub/scrub, greater than 30% cover

To better understand some of the values in Table 2 above, dividing BI by 10 can approximate flame length. On a VERY HIGH fire danger day (90th percentile) predicted flame lengths could range from 9 to 11 feet depending on the fuel type. On an EXTREME day (97th percentile), advise initial attack forces to expect flame lengths >11 feet. Any flame length over 4 feet is too intense for direct attack. Other suppression tactics, such as the use of water and foam, dozers, and indirect suppression response is necessary. Since grass is the primary fuel contributing to fire spread in most of the refuge habitats, fast moving fires will happen, potentially moving in excess of 2 miles per hour in cured grass or marsh habitat. Expect to catch a fire occurring in fuel model 3 or N (tall grass or marsh vegetation) at existing fuel breaks or a change to a different fuel type.

The Zone FMO or RFMC monitors fire potential throughout the year for the Refuge. Based on current and forecasted conditions, the District FMO will evaluate the need for additional planning actions and advise the RFMC of such actions or conditions. The RFMC will also be advised and consulted for any long-term fire season severity needs beyond the more short-term, pre-approved Refuge Step-Up Plan.

Table 2. above summarizes potential fire behavior for fuel models present on the Refuge. Local weather information was obtained from the Prime Hook NWR automated weather station, and archived precipitation data, Table 1 from surrounding weather stations. Fire Family Plus was used to generate outputs. Six years of fire weather data were available. As the database grows, output values will be adjusted so that the refuge can keep informed on high fire danger days and the greatest fire behavior potential. Additionally, the refuge can monitor predicted fire danger as prepared on a daily basis through the Prime Hook FTS weather station. Table 1. shows index break point by Fuel Model (FM) present on Prime Hook National Wildlife Refuge.

Figures 1 and 2 for BI and KBDI below are displayed for 5 day periods from 1995 to 2000, indices for fuel models L,R, and E are found in Appendix M. Figure 1 depicts BI average for fuel model N and figure 2 depicts the KBDI Fuel Model N.

Figure 1. BI Fuel Model N

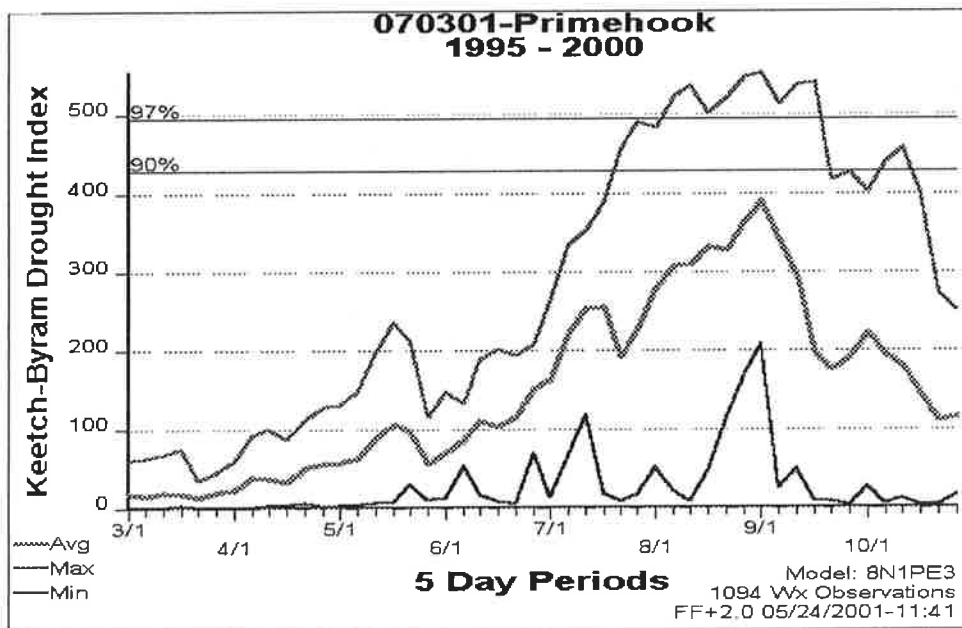
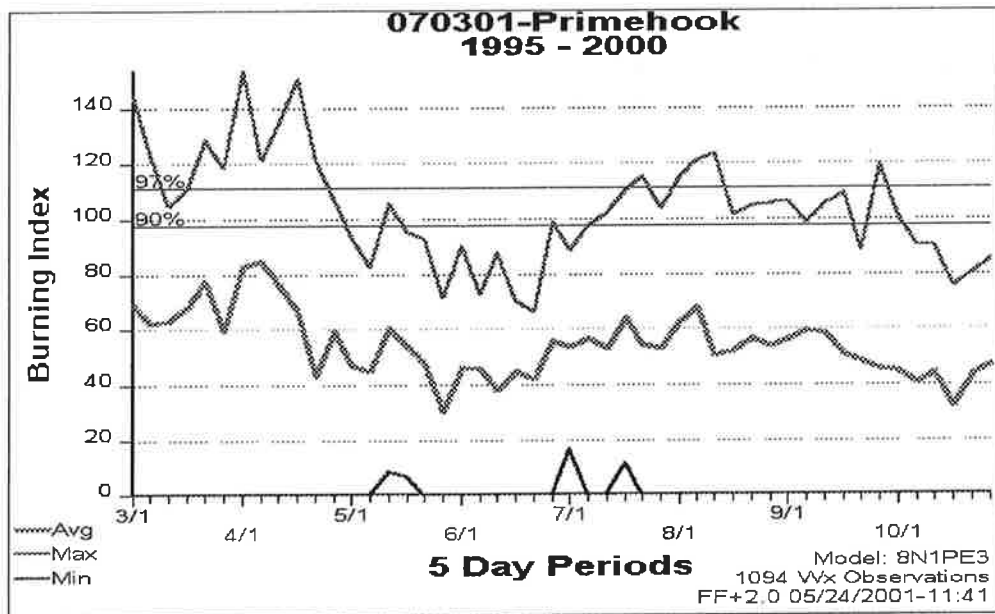


Figure 2. KBDI Fuel Model N



2. Fire Readiness and Planning

Fire readiness planning is to be done on an annual basis. This will ensure that all personnel, engines, fire cache, PPE, and training are identified and prepared for the fire season. Lists of engines, equipment, and inventory are located in Appendix N.

3. Fire Prevention

The refuge has a low fire consequence rating overall. However, high to extreme fire potential occurs seasonally on old field sites, and in monotypic stands of *Phragmites*. The borders of these areas contain fire breaks to reduce the potential for wildfires to spread from refuge lands to adjacent private property and cause damage to structures or crops.

An active fire prevention program will be conducted in conjunction with other agencies to protect human life and property, and prevent damage to cultural resources or physical facilities. A program of internal and external education regarding potential fire danger will be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards. Trained employees need to relate to the public the beneficial effects of prescribed fires as opposed to unwanted human-caused fires, with emphasis on information, essential to understanding the potential severity of human-caused wildland fires and how to prevent them.

It is essential that employees be well informed about fire prevention and the objectives of the Refuge's fire management program. Further, employees must be kept informed about changes in existing conditions throughout the fire season.

Fire prevention engineering is the process of reducing risks and hazards by removing accumulated fuels, removing fuels away from roadways and around structures, creating firebreaks around critically identified areas, and using spark arrestors on internal combustion engines and fireplaces. Prescribed fire will be used to reduce fuels, minimizing the threat of ignition and large scale fire spread. Other technical information on other engineering topics such as power lines, rights-of-way, and other activities are in the NWCG Wildfire Prevention Handbook.

During periods of extreme or prolonged fire danger emergency restrictions regarding refuge operations, or area closures may become necessary. Such restrictions, when imposed, will usually be consistent with those implemented by the Delaware Forest Fire Service and local fire departments. Closures will be authorized by the Project Leader.

The wildland-urban interface is an increasing problem with regard to the potential effects of wildfire along the Refuge perimeter. The encroachment of structures and developments into natural areas has made fire suppression and prevention activities even more complex. The operational roles of federal agencies as defined by the 2000 National Fire Plan and 2001 Federal

Wildland Fire Management Policy, are wildland firefighting, hazardous fuel reduction, cooperative prevention and education, and technical assistance. The refuge will expand efforts to identify wildland-urban interface problem areas, secure funding for fire prevention projects, and accelerate public education and outreach activities to increase public awareness of the risks to personal property.

4. Staffing

The Staffing (step-up) Plan (Appendix O.) is developed annually to provide adequate staffing for normal to the most severe fire weather conditions or increased National or Regional preparedness levels (IV or V). Elements of the plan include staffing levels and implementation (breakpoints), crew and equipment placement, and funding of emergency firefighters or additional duty hours . The Fire Staff will monitor current and predicted fire weather reports and preparedness levels for daily staffing.

5. Training

A training plan will be developed annually to identify individual training needs and to utilize interagency training opportunities. Service policy sets training, qualification, and fitness standards for all fire positions. All fire personnel (full time fire or collateral duty) will be provided with the training required to meet Service fire position qualification standards for the positions they are expected to perform. All firefighters will be required to participate in an annual refresher to remain qualified. Refreshers will focus on local needs, fire shelter deployment, LCES, fire orders, and watch out situations. On-the-job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The FMO will coordinate fire training needs with those of other nearby refuges, cooperating agencies, and the Region.

All fire qualified employees are required to pass the mandatory fitness requirements annually. Employees not meeting fitness and training requirements may assist in support capacities, but will not be permitted on the fireline. The refuge supports the development of individual firefighter personnel from among qualified and experienced refuge staff for assignment to local or regional crews.

6. Detection

The refuge relies on neighbors, visitors, staff, and cooperators to detect and report fires. The dispatch plan (Appendix P.) will be reviewed and updated annually. Copies will be kept at the refuge office and with local cooperators.

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All wildland fires will be suppressed. However, detection shall include a determination of fire cause. Moreover, human-caused fires will require an investigation and report by law enforcement

personnel. For serious human-caused fires, a qualified arson investigator will be requested.

7. Pre-Attack Plan

Pre-attack planning data will be updated annually by the fire staff. Pre-attack plans will be placed in the Engine and the refuge office. Pre-attack plans should include:

- Response map: roads, gates, water sources, mutual aid zones / fire cooperator districts.
- Hazard/Risk map: power lines, main ditches and canals.
- Natural and Cultural Resources map: sensitive zones, non-sensitive zones, restricted vehicle access areas.
- Structure list.

B. Prescribed Fire Management

1. Prescribed Fire Goals

Prime Hook National Wildlife Refuge has identified prescribed burning as one tool for management of the refuge resources. The prescribed fire activity is established and coordinated yearly as part of each Refuge's Habitat Management Plan. The use of prescribed fire to remove excess vegetation in grasslands and hardwood forests can create a mosaic that reduces fuel loading and provides quality habitat desirable for many wildlife species. The prescribed fire program goals are hazard fuel reduction and resource/ habitat management:

1. Hazard fuel reduction (mechanical removal or prescribed fire) should occur within or near Refuge development zones, sensitive natural resources, and boundary areas. These actions are intended to reduce the risk from wildland fire and to the greatest extent possible hazard fuel burns should compliment habitat/resource management objectives. Goals of hazard fuel reduction prescribed burning include:
 - maintain fuel loadings within the natural ranges (determined by fuel type)
 - protect habitat from wildfire trespass
 - establish defensible space around improvements and structures
2. Habitat/resource management prescribed fire is used to restore/create/maintain a diversity of plant communities in order to restore and perpetuate native wildlife species. The frequency of achieving many of the goals may require repeated, periodic prescribed burns. Goals of resource management burns include:
 - stimulate native upland species production
 - aid in control of noxious weeds.

2. Planning

The goals of prescribed burning on the refuge are to reduce hazardous fuel loads close to adjacent communities and to enhance habitat to meet refuge management objectives.

Reducing Fuel Loads

Prescribed fire will be used in the refuge marsh habitats to reduce fuel loads. Many of the refuge marshes which are adjacent to beach communities, contain high densities of *Phragmites*.

Prescribed Fire will be used to reduce standing dead canes of *Phragmites*. Prescribed fire will be timed to follow chemical treatment of *Phragmites*. The number of acres burned each year will vary according to refuge resources. The number of acres burned each year is expected to decrease as *Phragmites* is controlled.

Habitat Enhancement

Prescribed fire may be used in upland habitats to set back successional processes to meet refuge habitat management objectives. The refuge has traditionally used mowing from cooperative farming to maintain many of its old fields. Fire can be a cost effective way of maintaining these fields. Additionally as more lands are removed from the farming program, fire is an option the refuge may use to maintain these fields in grasslands. Fire may also be used to stimulate the growth of desirable plant communities in marsh habitats. The use of prescribed fire to enhance habitats will be limited until the Refuge develops an interim habitat management plan describing desired successional stages for current old field type habitats.

Prescribed fire has been used to enhance habitat for Delmarva Penninsula Fox Squirrels. The effects of fire on the success of Delmarva Penninsula Fox Squirrels are currently being studied. If results are favorable, the Refuge may seek to do prescribed burns in the 400 acre forest habitat currently used by the squirrels.

Each year the refuge will evaluate the appropriate use of prescribed fire to meet habitat management goals. The Fire Management Officer or Burn Boss will write individual prescribed fire plans (Appendix Q.) for the units to be treated. Annual Prescribed Fire Plans must be reviewed and signed by the designated Burn Boss, and Regional Fire Coordinator and approved by the Project Leader.

In addition, prescribed fire plans are submitted to the Delaware Fire Service for review. Due to the review process, plans should be submitted as early as possible. As a guide, all plans should be submitted no later than November 1st, for the upcoming burn season. Following the review, the Delaware Forest Fire Service will issue a burn permit.

A smoke management plan is required by the State and the prescribed fire plans include adequate information to meet the State requirement. The Air Quality permit is issued as part of the Prescribed Burn permit.

3. Preparation and Implementation

The District FMO shall assign the burn boss of the appropriate level to implement the burn. The burn boss will follow all the guidelines and procedures that are contained in the Prescribed Fire Plan.

The Refuge will meet or exceed standard and qualification requirements as outline in FWS Fire Management Handbook and Interagency prescribed fire qualification (NWCG publication 310-1). Due to a small refuge staff, the Refuge Manager and FMO will coordinate with the District prescribed fire crew and burn boss from Great Dismal Swamp NWR to ensure that there is adequate qualified staff to implement the fire program

5. Monitoring and Evaluation

Monitoring and evaluation are part of the prescribed fire process. Monitoring is conducted pre-burn, burn day, and post-burn. Pre-burn and post-burn evaluations are accomplished with transects or plots depending on the habitat type and fire unit.

Fuels treatment monitoring is part of the annual Prescribed Burn Plan to emphasize fuel management effectiveness monitoring and to guarantee the refuge's commitment to implementing and completing fire management and monitoring actions, from data collections to reporting and using the results. This monitoring plan will implement fuels treatment monitoring and link it to the prescribed burn plan for adaptive fire management.

The plan will include a full description of the monitoring design and analysis techniques that will be used, the specific fuels and wildlife habitat attributes that will be monitored, approved protocol descriptions in sufficient detail that a successor can continue monitoring efforts successfully, and the management actions to be taken when monitored habitat attributes reach established threshold criteria. Monitoring attributes will include fuel inventories and wildlife habitat characteristics such as composition, structure, cover frequency, density and/or production. The plan will also delineate field work schedules, procedures for recording data and how results will be reported.

Basic site conditions will be recorded during prescribed burns, to ensure that prescribed burning activity is within prescription, as required by Refuge Annual Prescribed Burn Plans. Site conditions monitored generally include temperature, relative humidity, mid-flame wind speed and direction, cloud cover one hour fuel moisture, and 10 hour fuel moisture. Measuring these additional parameters may yield important information for research-related prescribed fire. Basic fire behavior will be recorded to aid in post-burn evaluation, to determine if 1) the fire behaved as predicted; and 2) specific fire behavior can be linked to specific vegetation/habitat effects. Fire behavior to be monitored includes: type of fire (backing, heading, flanking), rate of spread, and intensity (inferred from flame length). Other possible parameters include: percent surface fuels burned, fuel consumption, burning duration, maximum temperatures, and soil heating.

No special equipment is necessary for monitoring fire behavior. Most burns will be low to moderate intensity and easily measured through rate of spread and flame length observations. Should more comprehensive fire behavior and effects information be necessary, it will be outlined in the Annual Prescribed Burn Plan.

Basic monitoring to determine habitat response will generally use photo-points, which will be re-

visted and photographed during subsequent seasons. Comparisons over time will aid in determining if burn objectives and resource goals are being met. More complex monitoring efforts may be undertaken for research-related prescribed burns, or to answer questions about the effects of prescribed fire on specific wildlife or other habitat parameters. Such monitoring can require vegetation transects, breeding bird point counts, presence/absence of target species, etc.

Hazard Fuel Reduction Operations (subactivity 9263) funds may be used to facilitate adaptive management when evaluating fuels management programs and project effectiveness, and to ensure that refuge resource management goals and objectives are not compromised by any of the fuel management projects. The use of 9263 funds will be limited to monitoring the first and second order effects of fuel management projects (prescribed fires, mechanical or chemical fuel treatments, etc.) on fuel and wildlife habitat composition and structure, as recognized and well-described as measurable objectives in an approved refuge habitat management plan. Monitoring will be limited to before and after treatment and at 1, 2, 5, 10, and 20 year after treatment intervals. Although funding wildlife population inventories or fire effects research or management studies on wildlife is not an appropriate use of 9263 funds, evaluating fuel management treatment effects on wildlife habitat composition and structure is intended to complement these inventories, management studies and research projects.

6. Complexity

A complexity analysis will be performed on all prescribed fires regardless of size. Completion of a prescribed fire complexity analysis will serve two purposes: 1) provide FIREBASE input used to determine programmatic funding and staffing needs, and 2) as an evaluation tool and critique mechanism for individual prescribed fire plans to determine areas of concern and where plan modification(s) may be appropriate.

Complexity analysis is an evaluation tool for prescribed fire planning modifications (Fire Management Handbook). A two-staged analysis effort will be used when developing Prescribed Fire Plans. An initial analysis will identify plan elements needing further attention or mitigation. In performing the initial analysis all areas both inside and outside the project boundaries will be considered to address the case of escaped fire. All values at risk outside the project area will be weighed to include surrounding beach communities and nearby farm operations. A final analysis once the prescribed burn plan is near completion will recheck and validate the initial complexity analysis.

Each complexity element will be compared to related Prescribed Fire Plan elements to determine the probability of an unexpected event or situation occurring (risk). The complexity analysis will also provide some measure of cost resulting from an undesirable event or situation occurring (potential consequences), and/or the level of skills needed to complete a given element, and if appropriate levels of preparedness are enough to deal with any unexpected event (technical difficulty) is acceptable and adequately addressed in the Prescribed Fire Plan.

7. Impacts

Based on the location of the Refuge in proximity to transportation routes and the developed nature of the lands surrounding the Refuges, one could easily conclude that prescribed fire could not be effectively used to achieve management objectives. The challenge for managers is to develop a strategy that effectively mitigates the impacts. Impacts that have been identified include:

15. A small staff with limited qualifications and experience.
16. A narrow burn window because of transport wind requirements, the soil moisture, and weather conditions.
17. Air Quality and public safety concerns resulting from smoke generated by prescribed firing operation.
18. Restrictions that reduce the opportunity to burn a given area using a variety of fire intensities necessary to stress or kill woody species and create a mosaic.
19. The close proximity to development (the wildland-urban interface) and the volume of traffic on area roads particularly State Route 1, the major north south highway and route to tourist areas.
20. The need to protect sensitive habitat(s) and nesting birds.

8. Reporting And Documentation

Individual prescribed burn plans will be the primary document used to record prescribed fire information. Burn plans document air quality requirements, personnel, costs, fire behavior, weather, fire summary, and burn critique information. Prescribed burns will also be documented on DI-1202 forms and entered into the DOI shared applications computer system.

9. Prescribed Fire Critiques And Plan Review

Prescribed fires will be critiqued by the burn boss and documented in the burn plan. The FMO and Project Leader will conduct a formal critique if:

- significant injury/accident occurs
- an escape prescribed fire occurs
- significant safety concerns are raised
- smoke management problems occur

C. Wildland Fire Suppression

1. Fire Management Units

There are four fire management units on the refuge. The Fire Management Units mimic existing management units that were designated for water control purposes. These units are noted numerically as 1,2,3,4 (Appendix R). All four units have vegetation capable of sustaining fire. All of the FMUs are located near populated areas at risk from fire. Unit 3 contains most of the refuge's improved structures that would be affected by fire. It is necessary to mandate total suppression of wildfires on each FMU. Fire escapes from the refuge would threaten private structures and improvements. As previously discussed, the entire refuge is currently broken down by fuel model types (see III A.1.b)

Fire Management Unit-1

FMU 1 is the northern most end of the Refuge. The 1404 acres in FMU1 lie between Slaughter Beach Road on the north and Fowlers Beach Road on the south. Barrier dunes and homes in the Slaughter Beach community are on the east. Privately-owned agricultural lands border the west. Salt marshes cover 77% of FMU-1. Remaining cover-types include forested wetlands, scrub-shrub wetlands, fringe deciduous forest, agricultural and fallow fields and grasslands.

Tidal salt water is the primary source of water for this unit, entering through Slaughter Canal which flows southward from the Mispillion River inlet. Tidal flow provided by Slaughter Canal bisects FMU-1 and receives its afflux from the various ditches and creeks within the salt marsh area. The Draper-Bennet Tax Ditch drains the southwest portion of FMU1, which finally drains into the Slaughter Canal. Daily tidal action has a 4.4 foot fluctuation and salinities range from 0 to 28 ppt in the canal. Rainfall, new and full moon tides, plus spring and neap tides maintain the salt marsh habitats within FMU1. There have been extensive Open Marsh Water Management treatments in FMU1.

Fires in Unit 1 can be very intense and spread quickly, fed by the large amounts of *Phragmites* that dominate the salt marsh (FBPS 3; NFDRS N). Roads on the north, south, and east provide a limited fire break. Fires that originate in the adjacent fallow fields (FBPS 1; NFDRS L) and fringe forest (FBPS 9; NFDRS E) are generally low intensity but have the potential to spread to *Phragmites*.

Specific Fire Management Goals:

- a. Protect human life and prevent property loss
- b. Where possible, suppress all fires through direct attack with full control suppression strategy
- c. Conduct hazard fuel reduction projects
- d. Explore restoration options to reduce dominance of *Phragmites*

Special Considerations:

- a. Close proximity to Slaughter Beach Community
- b. High potential for arson or accidental human cause wildfire

Fire Management Unit-2

FMU2 is 2063 acres bounded on the north by Fowler's Beach Road, barrier dunes on the east facing Delaware Bay, Prime Hook Beach Road on the south, and an upland interface on the west.

The water supply for FMU2 comes mainly from rainfall, washouts in the dunes during storm surges and from FMU3 through culverts under Prime Hook Beach Road. In addition to this, upland runoff, mainly from private agricultural lands, drain through FMU2 via Slaughter Creek, into Slaughter Canal. Salinity varies from 0 to 26 ppt. Active water management is practiced in this unit where about 1,500 acres are impounded. Tidal flow entering Slaughter Canal is held in check by a large water control structure located on the northern boundary at Fowler's Beach Road.

Fires in FMU2 are expected to vary from low to high intensities. Low intensities are expected in upland areas where fallow fields (FBPS 1; NFDRS L), shrubs (FBPS 5; NFDRS F or T), and fringe forests (FBPS 9; NFDRS E) dominate. In areas where *Phragmites* and cattails dominate (FBPS 3; NFDRS N) fires are expected to be very intense. Sensitive habitats include first and second hills and Negro Island, a nesting site for bald eagles.

Specific Fire Management Goals:

- a. Protect human life and prevent property loss
- b. Where possible, suppress all fires through direct attack with full control suppression strategy
- c. Conduct hazard fuel reduction projects

Special Considerations:

- a. Close proximity to Prime Hook Beach Community.
- b. Prime Hook Beach Road only ingress/egress for Prime Hook Beach Community.
- c. High potential for arson or accidental human cause wildfire.
- d. Protection of Oak Island cultural resource site from damage.

Fire Management Unit-3

FMU3 is 4,382 acres, bounded by Prime Hook Beach Road on the north, the Prime Hook Beach and Broadkill Beach communities on the east, Route 16 on the south, and upland habitats bordering State Route 1 in some areas. Active water management is also practiced in this unit where 2,500 acres are impounded. Water for this unit come primarily from Prime Hook Creek and from rainfall plus to a lesser extent from upland runoff from small ditches. Salinity varies from 0 - 5 ppt The refuge headquarters, maintenance compound, numerous public trails, and other improvements are located in FMU3 (Appendix L). FMU3 also contains a number of sites of historic and cultural value (Appendix K).

Fires in FMU3 are expected to vary from low to high intensities. Low intensities are

expected in upland areas where fallow fields (FBPS 1; NFDRS L), shrubs (FBPS 5; NFDRS F or T), and fringe forests (FBPS 9; NFDRS E) dominate. In marsh areas where *Phragmites* and cattails dominate (FBPS 3; NFDRS N) fires are expected to be very intense. However, due to Snow Goose eat outs and deeper water habitats, the rate of spread may be slower than expected in FMU3 marshes.

Specific Fire Management Goals:

- a. Protect human life and prevent property loss
- b. Where possible, suppress all fires through direct attack with full control suppression strategy
- c. Conduct hazard fuel reduction projects

Special Considerations:

- a. Close proximity to Prime Hook Beach and Broadkill Beach communities
- b. Prime Hook Beach Road only ingress/egress for Prime Hook Beach community
- c. Route 16, state maintained highway egress/ingress to Broadkill Beach Community
- d. High potential for arson or accidental human cause wildfire
- e. Protection of refuge improved property, visitors, and staff.
- f. Protection of historic and cultural resources
- f. Low intensity fires may benefit Delmarva Peninsula Fox Squirrel habitats

Fire Management Unit-4

FMU4 is 1238 acres bordered by Route 16 on the north, the Broadkill River on the south and west, and upland habitats along the western boundary. The Broadkill River flows into this unit and flow is controlled via two water control structures which impounds approximately 200 acres of marsh. Tidal range of the Broadkill River is from 2.1 to 5.5 feet and salinity values range from 5 to 30 ppt that enter this management unit. FMU4 has also received Open Marsh Water Management (OMWM) alterations in several salt marsh areas where 985 acres of grid-ditched areas were treated with 417 acres of constructed OMWM systems.

Fires in FMU4 are expected to vary from low to high intensities. Low intensities are expected in upland areas where fallow fields (FBPS 1; NFDRS L), shrubs (FBPS 5; NFDRS F or T), and fringe forests (FBPS 9; NFDRS E) dominate. In marsh areas where *Phragmites*, and saltmarsh grasses dominate (FBPS 3; NFDRS N) fires are expected to be very intense.

Specific Fire Management Goals:

- a. Protect human life and prevent property loss.
- b. Where possible, suppress all fires through direct attack with full control suppression strategy.
- c. Conduct hazard fuel reduction projects.

Special Considerations:

- a. Close proximity to Broadkill Beach community.
- b. Route 16 is state-maintained highway egress/ingress to Broadkill Beach Community.
- c. High potential for arson or accidental human cause wildfire.
- d. Protection of refuge improved property, visitors, and staff.
- e. Protection of historic and cultural resources.
- f. Protection of Black Rail habitats.
- g. Federal Aviation Administration property on-site.

2. Wildland Fire Use

The refuge is located in a populated community. It is bordered closely by private residences and large tracts of agricultural lands. The use of wildland fire for resource objectives is not feasible. All accidental fires will be suppressed.

3. Initial Attack

The Project Leader will ensure that a qualified Incident Commander (IC) is assigned for each fire occurring on the refuge, and an appropriate Delegation of Authority will be prepared in the event of extended attack (For a sample Delegation of Authority, see Appendix S.) If a qualified IC is not available, one will be ordered and a unified command will be established with a representative from the refuge. The IC will be responsible for all aspects of the management of the fire. The IC will select the appropriate suppression strategies and tactics. Minimum impact tactics will be used whenever possible. Dozers, plows, discs, or graders will not be used inside refuge boundaries without permission from the Project Leader or designate.

Mutual aid resources responding from fire departments or districts to Service fires will not be required to meet Service fire qualification standards, but must meet the standards set by their own department. Mutual aid resources will report to the IC (in person or by radio) for assignment and will be the first priority for release.

4. Extended Attack

The IC will notify the Project Leader whenever it appears that a fire will exceed initial attack efforts, threaten Service/private lands, or when fire complexity will exceed the capabilities of command or operations. The Project Leader will be responsible for coordinating with the IC all extended attack actions including:

- completion and daily review of a WFSA (wildland fire situation analysis)
- assignment or ordering of appropriate resources
- completion of Delegation of Authority if needed (Appendix S.)

5. Public Safety

Firefighter and public safety will always take precedence over property and resource protection during any fire management activity. The greatest threat to public safety from refuge wildland fires is entrapment by extremely fast moving fire fronts or fingers. Of particular concern are hunters or visitors who may be present in the area of the fire, and neighbors who initiate their own suppression actions without proper training, equipment, or communication. Staff will attempt to keep the fire scene clear of people except for Service firefighters and any resources requested from cooperators.

Smoke from a wildland fire is a concern, particularly smoke drifting into a roadway causing dangerously reduced visibility. The fire dispatcher will notify the Delaware State Police and the Milton and Milford Police Departments whenever the IC believes that smoke may be causing a safety hazard. The police departments can determine if road closure is necessary.

The final concern is for fires which might escape from the refuge and spread to inhabited private property. The IC is responsible for warning and evacuating the public from potentially dangerous wildland fires.

6. Rehabilitation

Most initial attack fires will generally not require rehabilitation measures, but each incident shall be evaluated independently to assess rehabilitation needs. Burned area emergency stabilization and rehabilitation (ESR) activities are an integral part of wildland fire incidents and Service ESR policy mandates that ESR be incorporated into refuge fire management planning. (Departmental and Service ESR policies in 620 DM 3 and 095 FW 3.9) Emergency stabilization is the use of appropriate emergency stabilization techniques in order to protect public safety, stabilize and prevent further degradation of cultural and natural resources within the perimeter of the burned area, and downstream impact areas from erosion, and thwart the invasion of exotic and other undesirable species.

Total rehabilitation of a burned area is not within the scope of ESR funding. Emergency Rehabilitation funding can be used to begin the rehabilitation process only if other funding is committed to continue ESR activities throughout the life of the project, i.e., beyond the initial 3 years of ESR funding.

The Refuge manager is responsible for preparing an ESR Plan. The goal of the ESR Plan is to protect public safety and stabilize and prevent further degradation of natural and cultural resources, and to rehabilitate the stability, productivity, diversity and ecological integrity of refuge lands after a large wildland fire incident. The ESR Plan is tiered to the Refuge's CCP, HMP and FMP and other step-down plans. Development of the ESR Plan objectives and constrains identified in approved CCP and HMPs.

Damage to improvements or to resources caused by fire suppression activities should be repaired using Suppression Operations funds (subactivity 9261). These types of activities are: 1.)

replacement of soil and/or seeding vegetation on fire control lines, 2.) repair of structural improvements or facilities (fences, roads, etc.,) damaged by suppression activity, and 3.) slash mitigation, where fire suppression activities generated the unnatural accumulation of slash.

The refuge manager is responsible for Burned Area Emergency and Rehabilitation Plan development which, depending on the size of the fire and extent of damages, may include assembling a burned area ESR team to conduct fire damage assessments that begins the plan development. This team will use refuge wildlife and vegetation inventories, cultural and historical location data, threatened and endangered and other sensitive species information, fire history, fire ecology, fire severity, FEIS - Fire Effects Information System, VEGSPEC (NRCS-USGS) info and any other resource and fire data available to assess the impacts of wildland fire on ecosystem health, threatened and endangered species, Native American or other historical resources on Refuge to evaluate and ascertain the appropriate stabilization and rehabilitation actions to be taken. After several field inspections of the burned area a fire damage assessment will be prepared as per Fire Management Handbook section 5.4 Guidelines.

7. Records and Reports

The fire staff will complete all situation reports as soon as practical. The IC will complete the DI-1202 Fire Report and Crew Time Reports for all personnel assigned to the fire, and in the case of the 1202 return to the FMO for entry into the DOI Computer (SACS). The FMO will ensure that all expenses or items lost on the fire are reported, that the timekeeper is advised of all fire time and premium pay to be charged to the fire, and that expended supplies are replaced.

8. Fire Critiques and Plan Review

Wildland fires will be critiqued by the IC. The FMO, RFMC, and others as appropriate will conduct formal fire critiques in the event of:

- significant injury/accident
- significant property or resource damage
- significant safety concerns
- an extended attack

IV. Air Quality and Smoke Management Guidelines

As an ecological process, fire has been and will continue to be a significant influence in restoring and maintaining resource benefits; however, fire produces combustion byproducts that can be harmful to human health and welfare. The refuge will manage smoke from prescribed fires to minimize negative impacts to air quality.

Clean air is a primary natural resource value in all Service operations. Public health standards fall under the Clean Air Act. All Service fire management activities which result in the discharge of air pollutants (particulates, carbon monoxide, and other pollutants) from fires are subject to, and must comply with, all applicable Federal, state, interstate, and local air pollution control requirements as specified by Section 118 of the Clean Air Act, as amended (42 USC 7418).

Smoke from wildland and prescribed fires is inventoried and managed differently. Wildfires are natural events and their emissions are addressed by the Natural Events Policy. Emissions from prescribed fire (visibility, haze standards, etc) are addressed by EPA's Interim Air Quality Policy in Prescribed Fire. The states use these policy documents to develop State Implementation Plans and Smoke Management Programs (SMP). The refuge's smoke planning process will incorporate Delaware's SIP and SMP public health standards.

Refuge compliance responsibilities are to protect the air resource from the harmful effects of smoke and comply with the state regulations and standards, and take aggressive action to manage smoke from wildland fires to minimize impacts and maintain air quality. To accomplish this, the effects of smoke on air resources will be identified, current levels of pollutants established, levels of pollution for different fire management actions estimated, the effects on visitor health and enjoyment identified, and the best measures to control and mitigate prescribed fire smoke emissions and effects will be energetically pursued.

State Agency Coordination

Refuge personnel will coordinate fire and smoke management planning with Delaware's Department of Natural Resources and Environmental Control. Refuge staff will work with the Air Quality Management Section and acquire all necessary Burn Permits and other documents.

Public health standards of pollutant concentrations will be based on National Ambient Air Quality Standards and Delaware's SIP and SMP standards. Of the criteria pollutants in smoke, particulate matter is of most public health concern. National particulate matter standards are established as annual values (PM_{10} - 10-50 g/m^3 and $PM_{2.5}$ - 2.5- 15 g/m^3), and 24 hour values (PM_{10} 10-150 g/m^3 and $PM_{2.5}$ 2.5065 g/m^3) averages. The 24 hour standard is more critical since wildland and prescribed fires are very episodic (both within and between years). Maintaining emissions below the 24 hour average will be the key to achieving conformity with state standards.

Air quality management objectives will be set and prescriptions and techniques will be developed to meet these objectives in all Prescribed Fire Plans. The Refuge will identify the key smoke

sensitive areas for which smoke objectives will be developed. Selected air quality management objectives will be quantifiable and measurable at designated points in the Refuge. Objectives will include maintenance of acceptable visual range, allowable loss of detail or clarity of key features, the number of consecutive days in which the visual range is attenuated below the acceptable standard, consecutive nights with the odor of smoke in developed areas, and the maintenance of acceptable visibility on highways.

Several emission and impact reduction tactics will be used in all planned prescribed fires to achieve fire management objectives and conform with public health and welfare standards. Emission strategies will be designed to reduce and/or minimize 24-hour values. The preferable Service emission reduction strategies include permanent fuel exclusion, temporary fuel exclusion, increasing combustion efficiency and emission redistribution. The specific techniques will be defined in a similar fashion to the way burning prescriptions are defined for the achievement of fire management objectives. Critical mixing heights, transport wind speeds and directions, fuel concentrations at or above moisture of extinction rates, scheduling burns before new fuels appear, creating mosaics of burns, methods to increase combustion efficiency, rapid mop-ups and other appropriate smoke reduction techniques will be considered.

Prescribed fire plans will describe the methods which will be used to monitor and measure the degree to which objectives have been met or violated. The plan will also describe the amount or periods of time that air quality objectives may be violated before the fire is declared an unwanted wildfire and appropriate suppression actions to be taken. These time periods will be discussed with Delaware's Air Quality regulatory office.

If a prescribed fire is not meeting smoke management objectives or is exceeding prescription parameters, a WFSA will be completed and the appropriate management response(s) implemented. The fire will remain an unwanted wildland fire even if dispersal conditions improve again to prescribed standards. The suppression strategies chosen and tactics employed will also incorporate smoke objectives.

Prescribed Fire Plans and the WFSA will describe the holding actions to be used to keep fire within prescription for air quality objectives, especially when smoke dispersion is deteriorating to the point that smoke and air quality objectives will no longer be achieved. These actions may include:

- Using firing crews to ignite fuels so that the fuels burn with flaming rather than smoldering combustion
- Using natural barriers or constructing firelines to halt fire spread
- Mopping up smoldering fuels until conditions improve for smoke dispersion, at which time the fire may be re-ignited
- Use hose lays and pumps to wet fuels to extinguish all or a portion of the fire front, with possible subsequent re-ignition under prescribed dispersal conditions.

Smoke management is a rapidly evolving and highly technical field. New technology is constantly being developed to better model and predict plume rise and smoke dissipation. The following

smoke management guideline publications provide sound management principles that will be used in developing Refuge smoke management plans:

- Southern Forestry Smoke Management Guidebook. Mobley et al., USDA Forest Service GTR SE-10, December 1976.
- Prescribed Fire Smoke Management Guide. National Wildfire Coordinating Group (NWCG) No. 420-1, February, 1985.
- Smoke Signals. An on-line USFWS information resource for responsible wildland and prescribed fire smoke management. Smoke Signals also contains other smoke management guides applicable to the region, and smoke management models such as SASEM, CONSUME, FOFEM, etc.)
- When and How to Monitor Prescribed Fire Smoke: A Screening Procedure, USDA Forest Service, Pacific Northwest Region, September, 1977.

Smoke management principles that will be incorporated in Refuge prescribed fire plans include:

- delineating clear and defensible objectives, not to burn during pollution alerts or temperature inversions as smoke tends to stay near the ground and not disperse,
- comply with all state air pollution regulations, burn when conditions are good for rapid dispersion,
- determine the direction and volume of smoke by using screening procedures in making these determinations,
- notify local fire departments, nearby landowners and beach community residents, use test fires to confirm smoke behavior,
- use backing fires where possible, as backing fires provide more complete consumption of fuels and produce less smoke,
- burn in small blocks,
- use rapid mop-up along roads by starting mop up procedures along roads as soon as possible to reduce impact on visibility,
- have an emergency plan if sudden wind direction changes occur,
- burn when duff and soil moistures are high to prevent smoldering ground fires,
- burn under conditions of low relative humidity and fuel moistures because smoke particles combine with moisture to enhance poor visibility, and avoiding days with low morning transport wind speed (less than 4 mph) or low mixing heights (less than 1,500 feet).

Smoke management parameters that will be used in evaluating set objectives for monitoring purposes will include:

- visibility
- particulates
- carbon monoxide
- total smoke production
- mixing heights
- transport and surface wind speeds and directions
- complaints or the maximum allowable number of "recordable" complaints per treatment, as defined by the State of Delaware's Air Quality Management Section.

V. Public Information and Education

Educating the public on the values of both clean air and the natural process of fire will be instrumental in increasing public understanding and supporting the Refuge's Prescribed Fire Programs. Interpretation and specially conducted fire management educational programs on the Refuge will be the primary methods used for providing this prescribed fire education. The public will be made aware of how the Service is endeavoring to protect air resources and simultaneously using fire to both simulate natural ecological processes and as a tool to accomplish resource management objectives. Shortly before prescribed burns are to be conducted, information will be disseminated to state contacts, Refuge visitors, local citizenry and the press of prescribed fire events.

The safety of all wildland and prescribed firefighters and the public is the first priority in every fire management activity. The fire scene must be secured from the public. Depending upon incident complexity, access may have to be restricted or prohibited. This is an especially important consideration for any fires occurring within the eastern boundaries of FMU-1, FMU-3, and FMU-4, that run parallel to Slaughter Beach, Prime Hook Beach and Broadkill beach communities respectively. Fire intensities and/or smoke may preclude safe passage, and traffic may impair timely arrival of fire management resources to the fire. Temporary road closures and/or parking restrictions will be employed to ensure a timely and efficient initial response to any incident. If adequate Refuge personnel are not available, other personnel, particularly local cooperators' fire police, state police, if necessary, highway department units or suitably trained and equipped volunteers will be used.

The Refuge will enhance public knowledge and understanding of wildland fire management policies and prescribed fire practices through internal and external communication and fire education programs. These programs will be continuously improved through timely and effective exchange of information between the Refuge, the local public and state partners.

Local news media frequently arrive unannounced at wildland fire scenes or prescribed burns. Working with the local media will help keep the public informed in a timely manner. The assigned Refuge Incident Commander will be responsible for assuring that media activities do not jeopardize the safety of fire management personnel, the media members, or the effectiveness of on-going fire management operations. No media personnel will be permitted on fire lines without required personal protective equipment, including fire shelters, and must be accompanied by a Refuge representative with communications to the Incident Commander. Media personnel will be accompanied at all times. The Refuge's assigned Information Specialist will handle all incident information formulation and dissemination to the news media, personnel, and other agencies at the first indications of on-scene media interest. The same situation will be applied to prescribed burns. The public will be kept informed using news releases and public service announcements.

VI. Consultation and Coordination

Fire management planning, preparedness, prevention, suppression, fire use, restoration, rehabilitation, monitoring, research and education will be conducted on an interagency basis with the involvement of cooperators and partners. Prime Hook NWR's Fire Management Plan strives to protect human life, property, and preserve and enhance natural resources as guided by Refuge management purposes, goals and objectives. All associated fire management programs will be based on a foundation of sound scientific knowledge of biological, physical, and sociological factors. Good communications aimed at keeping all affected and interested parties informed will be the key to ensuring the success of all fire management programs. Special communication efforts will be geared to adjacent landowners and local beach community residents.

Maintaining good working relations with the Delaware Department of Agriculture Forestry Service and the Slaughter Beach and Milton Fire Departments will ensure the success of all the Refuge's fire management programs. In addition, consulting with the FWS Ecological Services staff in Chesapeake Bay Field Office on the Endangered Species Act, the Regional Historic Preservation Officer, and the State Historic Preservation Officers, may be necessary for certain activities. Consultation and Coordination may also be necessary with the U.S. Army Corps of Engineers on Section 404 (Clean Water Act) compliance and or Delaware's air quality regulatory offices.

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Appendix B. Definitions

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Burning Index. A number combining the spread and energy release component related to the contribution of fire behavior to the effort of containing a fire.

Class of Fire (as to size of wildland fires):

Class A - $\frac{1}{4}$ acre or less.

Class B - more than $\frac{1}{4}$ but less than 10 acres.

Class C - 10 acres to 100 acres.

Class D - 100 to 300 acres.

Class E - 300 to 1,000 acres.

Class F - 1,000 to 5,000 acres.

Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire A wildland fire that threatens or involves structures.

Appendix C. Authority and Guidance for Fire Management Plan

- Protection Act of September 20, 1922 (42 Stat. 857; 16 U.S.C.594): authorizes the Secretary of the Interior to protect from fire, lands under the jurisdiction of the Department directly or in cooperation with other Federal agencies, states, or owners of timber.
- Economy Act of June 30, 1932: authorizes contracts for services with other Federal agencies.
- Reciprocal Fire Protection Act of May 27, 1955 (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b): authorizes reciprocal fire protection agreements with any fire organization for mutual aid with or without reimbursement and allows for emergency assistance in the vicinity of agency lands in suppressing fires when no agreement exists.
- Disaster Relief Act of May 22, 1974 (88 Stat. 143; 42 U.S.C. 5121): authorizes Federal agencies to assist state and local governments during emergency or major disaster by direction of the President.
- National Wildlife Refuge System Administrative Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd et seq.: defines the National Wildlife Refuge System as including wildlife refuges, areas for the protection and conservation of fish and wildlife which are threatened with extinction, wildlife ranges, game ranges, wildlife management areas and waterfowl production areas. It also establishes a conservation mission for the Refuge System, defines guiding principles and directs the Secretary of the Interior to ensure that biological integrity and environmental health of the system are maintained and that growth of the system supports the mission.
- Federal Fire Prevention and Control Act of October 29, 1974 (88 Stat. 1535; 15 U.S.C.2201): provides for reimbursement to state or local fire services for costs of firefighting on federal property.
- Wildfire Suppression Assistance Act of 1989. (P.L. 100-428, as amended by P.L 101- 11, April 7, 1989).
- Departmental Manual (Interior), 620 Chapter 1, Wildland Fire Management (April 10, 1998): defines Department of Interior Fire Management Policies.
- National Environmental Policy Act of 1969: encourages the combination of environmental comments with other agency documents to reduce duplication and paperwork (40 CFR 1500.4(o) and 1506.4).
- Clean Air Act (42 United State Code (USC) 7401 et seq.): requires states to attain and maintain the national ambient air quality standards adopted to protect health and welfare. This encourages states to implement smoke management programs to mitigate the public health and welfare impacts of Wildland and prescribed fires managed for resource benefit
- Endangered Species Act of 1973.
- Federal Fire Management policy of 1995

Appendix D. Current Fire Management Staff

The following is a listing of Refuge staff serving on the Fire Management Team by name, position and qualifications.

Employee	Position	Qualifications
Barron Crawford	Project Leader	Firefighter 2
Kate McManus	Deputy Refuge Manager	Fire Financial Manager
George F. O'Shea	Assistant Refuge Manager	Firefighter 2
Annabella C. Larsen	Wildlife Biologist	Firefighter 2 Prescribed Burn Boss Type 3
Dale Hudson	Tractor Operator	Firefighter 2 Law Enforcement Pumps and Saws
Frank Buck	Tractor Operator	Firefighter 2
Bill Jones	Outdoor Recreation Planner	In Training
Louise Kotarba	Office Assistant	Timekeeper/ Administration
Kelly Hudson	Office Assistant	Timekeeper/ Administration

Appendix E. Current Cooperative Agreements

1. Slaughter Beach Memorial Fire Company
2. Milton Fire Department, Inc.

FIRE CONTROL COOPERATIVE AGREEMENT
BETWEEN THE
PRIME HOOK NATIONAL WILDLIFE REFUGE
U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
AND THE
MEMORIAL VOLUNTEER FIRE CO.(SLAUGHTER BEACH)

THIS AGREEMENT is made by and between the Memorial Volunteer Fire Co.(Slaughter Beach), and the U.S. Fish and Wildlife Service, under the authority of "The Protection Act of September 20, 1922" (42 Stat. 857; 15 U.S.C. 594), the "Reciprocal Fire Protection Act of May 27, 1955" (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b) and the corporation "By-laws of Memorial Volunteer Fire Co."

WITNESSETH:

WHEREAS, the U.S. Fish and Wildlife Service (hereinafter the "Service") is the agency of the Federal Government primarily responsible for welfare and protection of lands and wildlife within the boundaries of the Prime Hook National Refuge (hereinafter the "Refuge"); and

WHEREAS, it is the desire of the Service to provide maximum protection of the refuge, its lands, wildlife, personnel, and facilities from fire; and

WHEREAS, it is the desire of the Memorial Volunteer Fire Co., (hereinafter referred to as the "Fire Department") to provide protection for its lands, citizens, and buildings within the fire district from fire; and

WHEREAS, Memorial Volunteer Fire Co., is a volunteer company whose sub-sistence is dependent upon annual contributions from the fire district and minimal State funding; and

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual," of fire management is, "...to protect and enhance habitat for fish and wildlife production and diversity, and to protect and enhance natural ecosystems on these (refuge) lands." And;

WHEREAS, it is desirable for both parties to establish a cooperative agreement toward meeting the need for prevention, detection, and suppression of wildlands fires within the Prime Hook National Wildlife Refuge, provided, however, that a mutual understanding is reached between both parties on the following matters:

ARTICLE I. Definitions

1. Refuge Lands: Lands administered and/or protected by the Prime Hook National Wildlife Refuge/U.S. Fish and Wildlife Service; these lands constitute the Refuge's jurisdictional area.

2. Fire District: Lands protected by the Fire Department; these lands constitute the Fire Department's jurisdictional area.

3. Wildlands Fire: A fire that burns uncontrolled in vegetative or associated flammable materials, fires principally involving structures or facilities are not included.

ARTICLE II. The Fire Department Agrees:

1. To provide, as is available, the manpower and equipment necessary and available for use, to suppress wildlands fires on lands within the Refuge, under the direction of the Fire Chief or other superior officer of the Fire Department, and in cooperation with the Refuge Manager, or his designated representative.

2. To notify the Refuge when suppression equipment and personnel are not available for any wildfires on the refuge.

ARTICLE III. The Refuge Agrees:

1. To provide, when available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress fires on Refuge lands.

2. During suppression activities by the Fire Department of wildlands fires on lands within the Refuge, to delegate the authority to the Fire Department necessary to put the Fire Chief, or his designee, in command of the firefighting effort.

3. As conditions permit, maintain a firebreak west of the improved and developed properties adjacent to Slaughter Beach.

ARTICLE IV. Meetings and Designations of Head Agency

The parties hereto shall meet at least annually, prior to April 1, to review operations and planning hereunder. It is agreed that the Refuge Manager, Prime Hook National Wildlife Refuge, shall be responsible for setting a mutually convenient date, time, and place of said meeting.

ARTICLE V. Special Provisions

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provide herein.

3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.

4. Copies of fire reports shall be mutually provided to the other agency (ies) involved in the fire suppression as soon as possible following the fire action.

5. The Service will reimburse the Fire Department for actual suppression cost, as per the attached schedule, not to exceed \$1,000 per response or \$10,000 per fiscal year without further approval of the Refuge Manager.

6. A list of equipment susceptible to a liability claim is attached as part of the addendum. The Refuge Manager will be contacted by the Fire Department to assist in the filing of such a claim within thirty (30) days of the incident. Such liability does not extend to loss of life.

7. Nothing herein contained shall be construed as binding the Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or administratively allocated for the purpose of this Agreement for the fiscal year, or to involve the Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

8. Reimbursement to the Fire Department for suppression of fires originating on the refuge and burning both on and off the refuge will be determined by prorating the total suppression costs of both parties based on the number of acres burned.

9. No member of or delegate of Congress or resident commissioner after his election or appointment, either before or after he has qualified and during his continuance in office; and no officer, agent or employee of the Federal government shall be admitted to any share or part of this contract or agreement or to any benefit arising therefrom. The provision herein, with respect to the interest of members of or delegates to Congress and resident commissioners in this agreement shall not be construed to extend to an incorporated company where such contract or agreement is for the general benefit of such corporation.

ARTICLE VI. Modification and Duration

1. THIS AGREEMENT shall become effective on the last day of signing below and shall continue in effect until September 30, 1987, and shall be considered as automatically extended for one (1) year each October 1 thereafter, until terminated.

2. Each party hereto shall be obligated to submit to the other copies of any legislation or regulation hereinafter adopted which comes to the attention of that party, which in any way affects the provisions of this agreement.

3. THIS AGREEMENT may be amended by written mutual consent of the parties hereto, or may be terminated by either party giving the other at least (30) days written notice in advance; but such termination shall not relieve either party of obligation left outstanding under the terms of this agreement.

APPENDIX A

SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Memorial Volunteer Fire Co., for services as listed below and paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the Station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

- A. Actual suppression activities: \$100.00/unit per hour.
- B. Mop-up, overhaul, fire watch and other specifically authorized post suppression activities: \$70.00 per hour.
- C. Rescue Equipment: \$100.00 per use.

MAJOR EQUIPMENT: MEMORIAL VOLUNTEER FIRE CO. (SLAUGHTER BEACH)

<u>UNIT</u>	<u>TYPE</u>	<u>MAKE</u>	<u>DESCRIPTION</u>	<u>CURRENT VALUE</u>	<u>SERIAL NUMBER</u>
89-1	Pumper	1980 - Hahn	1000 gal/1250 gpm	\$76,000	HCP226127932
89-3	Brush Truck	1986 - GMC	250 gals/60 gpm	\$32,000	1GTHK343GS5183
89-4	Pumper	1961 - Ford	800 gals/750 gpm	\$15,900	218531
89-5	Rescue	1981 - Ford	Rescue	\$49,000	TK1FDNF60H1BVA 09658
89-6	Tanker	1979 - Poler International Truck	7,300 gals/750 gpm	\$20,000	4535
89-10	Generator	Kurtz & Root	15 KW	\$ 6,600	286AY2480N
A-89	Ambulance	1970 - Cadillac		\$ 6,600	211130

MEMORIAL VOLUNTEER FIRE CO. (SLAUGHTER BEACH)

SLAUGHTER BEACH, DELAWARE

Harlan R Swann Jr DATE: 5-12-87
President

Paul J. [Signature] DATE: 5-12-87
Chief

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE - PRIME HOOK NATIONAL WILDLIFE REFUGE

[Signature] DATE: 3/18/87
ACTING Regional Director, Region Five

FIRE CONTROL COOPERATIVE AGREEMENT
BETWEEN THE
PRIME HOOK NATIONAL WILDLIFE REFUGE
U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
AND THE
MILTON FIRE DEPARTMENT, INC.

THIS AGREEMENT is made by and between the Milton Fire Department, Inc., and the U.S. Fish and Wildlife Service, under the authority of "The Protection Act of September 20, 1922" (42 Stat. 857; 15 U.S.C. 594), the "Reciprocal Fire Protection Act of May 27, 1955" (69 Stat. 66, 67; 42 U.S.C. 1856, 1856a and b) and the corporation "By-laws of Milton Fire Department, Inc."

WITNESSETH:

WHEREAS, the U.S. Fish and Wildlife Service (hereinafter the "Service") is the agency of the Federal Government primarily responsible for welfare and protection of lands and wildlife within the boundaries of the Prime Hook National Refuge (hereinafter the "Refuge"); and

WHEREAS, it is the desire of the Service to provide maximum protection of the refuge, its lands, wildlife, personnel, and facilities from fire; and

WHEREAS, it is the desire of the Milton Fire Department, Inc., (hereinafter referred to as the "Fire Department") to provide protection for its lands, citizens, and buildings within the fire district from fire and

WHEREAS, Milton Fire Department, Inc., is a volunteer company whose subsistence is dependent upon annual contributions from the fire district and minimal State funding; and

WHEREAS, the objective, as stated in 6 RM 7.3 of the "Refuge Manual," of fire management is, "...to protect and enhance habitat for fish and wildlife production and diversity, and to protect and enhance natural ecosystems on these (refuge) lands." And;

WHEREAS, it is desirable for both parties to establish a cooperative agreement toward meeting the need for prevention, detection, and suppression of wildlands fires within the Prime Hook National Wildlife Refuge, provided, however, that a mutual understanding is reached between both parties on the following matters:

ARTICLE I. Definitions

1. Refuge Lands: Lands administered and/or protected by the Prime Hook National Wildlife Refuge/U.S. Fish and Wildlife Service, these lands constitute the Refuge's jurisdictional area.

2. Fire District: Lands protected by the Fire Department; these lands constitute the Fire Department's jurisdictional area.

3. Wildland Fire: A fire that burns uncontrolled in vegetative or associated flammable materials, fires principally involving structures or facilities are

not included.

ARTICLE II. The Fire Department Agrees:

1. To provide, as is available, the manpower and equipment necessary and available for use, to suppress wildlands fires on lands within the Refuge, under the direction of the Fire Chief or other superior officer of the Fire Department, and in cooperation with the Refuge Manager, or his designated representative.

2. To notify the Refuge when suppression equipment and personnel are not available for any wildfires on the refuge.

ARTICLE III. The Refuge Agrees:

1. To provide, when available, the manpower and/or equipment necessary and available for use, upon request by the Fire Chief, to suppress fires on Refuge lands.

2. During suppression activities by the Fire Department of wildlands fires on lands within the Refuge, to delegate the authority to the Fire Department necessary to put the Fire Chief, or his designee, in command of the firefighting effort.

3. As conditions permit, maintain a firebreak west of the improved and developed properties adjacent to Prime Hook Beach.

ARTICLE IV. Meetings and Designations of Head Agency

The parties hereto shall meet at least annually, prior to April 1, to review operations and planning hereunder. It is agreed that the Refuge Manager, Prime Hook National Wildlife Refuge, shall be responsible for setting a mutually convenient date, time, and place of said meeting.

ARTICLE V. Special Provisions

1. This agreement shall not affect the rights of any party to recover suppression costs and/or damages sustained as a result of the negligent or willful act of any person causing a fire.

2. No party shall be liable to any other for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement, except as provided herein.

3. The parties may work jointly on fire trespass investigations and fire law enforcement. Reports thereof may be prepared independently and separately.

4. Copies of fire reports shall be mutually provided to the other agency (ies) involved in the fire suppression as soon as possible following the fire action.

5. The Service will reimburse the Fire Department for actual suppression costs, as per the attached schedule, not to exceed \$1,000 per response or \$10,000 per fiscal year without further approval of the Refuge Manager.

6. A list of equipment susceptible to a liability claim is attached as part of the addendum. The Refuge Manager will be contacted by the Fire Department to assist in the filing of such a claim within thirty (30) days of the incident. Such liability does not extend to loss of life.

7. The parties hereto agree to waive any and all claims for loss, damage, personal injury, or death occurring in consequences of the performance of this agreement, except as otherwise provided herein.

8. Nothing herein contained shall be construed as binding the Service to expend in any one fiscal year any sum in excess of appropriations made by Congress or administratively allocated for the purpose of this Agreement for the fiscal year, or to involve the Service in any contract or other obligation for the further expenditure of money in excess of such appropriations or allocations.

9. Reimbursement to the Fire Department for suppression of fires originating on the refuge and burning both on and off the refuge will be determined by prorating the total suppression costs of both parties based on the number of acres burned.

10. No member of or delegate of Congress or resident commissioner after his election or appointment, either before or after he has qualified and during his continuance in office; and no officer, agent or employee of the Federal government shall be admitted to any share or part of this contract or agreement or to any benefit arising therefrom. The provision herein, with respect to the interest of members of or delegates to Congress and resident commissioners in this agreement shall not be construed to extend to an incorporated company where such contract or agreement is for the general benefit of such corporation.

ARTICLE VI. Modification and Duration

1. THIS AGREEMENT shall become effective on the last day of signing below and shall continue in effect until September 30, 1985, and shall be considered as automatically extended for one (1) year each October 1 thereafter, until terminated.

2. Each party hereto shall be obligated to submit to the other copies of any legislation or regulation hereinafter adopted which comes to the attention of that party, which in any way affects the provisions of this agreement.

3. THIS AGREEMENT may be amended by written mutual consent of the parties hereto, or may be terminated by either party giving the other at least (30) days written notice in advance; but, such termination shall not relieve either party of obligation left outstanding under the terms of this agreement.

APPENDIX A

SCHEDULE OF SUPPRESSION REIMBURSEMENT

The U.S. Fish and Wildlife Service will reimburse the Milton Fire Department, Inc. for services as listed below and paid in half hour increments calculated from the time the suppression unit leaves the Station until it arrives back at the station.

A fire suppression unit is any truck with water carrying and pumping capability which is attended by a crew of at least two operators/firefighters.

- A. Actual suppression activities: \$100.00/unit per hour.
- B. Mop-up, overhaul, fire watch and other specifically authorized post suppression activities: \$70.00 per hour
- c. Rescue Equipment: \$100.00 per use.

MAJOR EQUIPMENT: MILL FIRE COMPANY, INC.

TYPE	YEAR	MAKE	DESCRIPTION	CURRENT VALUE	SERIAL NUMBER
Fire truck	1977	Ford	750 gallon, pumps 750 gal/min	\$51,000	
Pumper truck	1961	Ford La France	1000 gallon, pumps 750 gal/min	16,000	
Pumper truck	1961	Ford La France	1000 gallon, pumps 1200 gal/min	16,000	
Fire truck	1969	American La France	1250 gallon, pumps 500 gal/min	76,251	
Fire truck	1971	American La France	1200 gallon, pumps 500 gal/min	74,000	
Ambulance	1977	Chevrolet	ambulance	42,000	
Ambulance	1983	Ford	ambulance	27,900	
Rescue/command	1969	Ford	Rescue/command	40,000	
Radio Portable		General Electric	4 each - portable	2,000 (total)	
Boat		Boston Whaler	16' 7" long	6,895	

THE MILTON FIRE DEPARTMENT INC.

MILTON, DELAWARE

President

DATE: _____

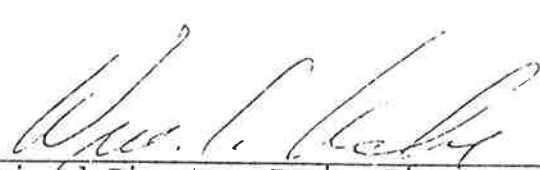
Chief

DATE: _____

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE - PRIME HOOK NATIONAL WILDLIFE REFUGE

DEPUTY



Regional Director, Region Five

DATE: 6/13/85

Appendix F. Dispatch Plan

PRIME HOOK NATIONAL WILDLIFE REFUGE

FIRE DISPATCH PLAN

Most refuge fires will be reported directly to the Sussex County Fire department Call Board in Georgetown, DE. As the situation permits, the call board will notify the Refuge or, if after hours or a weekend, the person designated by the Refuge Manager.

When a report or smoke or fire is received, get as much information from the caller as possible:

Location of smoke or fire: _____

Location of caller: _____

Name and telephone number of caller: _____

Color of smoke: _____

Size of fire: _____

Type of fuel: _____

Character of the fire (running, smoldering, etc.): _____

Is anyone fighting the fire?: _____

Did they see anyone in the vicinity or vehicles leaving the area? Get description and/or vehicle registration number: _____

Weather at fire location: _____

1. Check map location and ownership/ protection status.

2. Contact Sussex County Fire Department Call Board (911)
3. Dispatch appropriate Refuge personnel.
4. Notify Project Leader or Acting Project Leader.
5. Maintain communication log of all telephone calls and radio transmissions.
6. Remain on duty and dispatch additional personnel or equipment as is ordered at the fire scene.

REFUGE PERSONNEL

M-17	Barron Crawford, Project Leader	434-7625 (Home) 236-1970 (Mobile)
M-18	Kate McManus, Deputy Project Leader	430-0540 (Home) 610-733-6409 (Cell)
M-14	Kelly Hudson, Admin. Support	335-3836 (Home)
M-7	Dale Hudson, Tractor Operator/ Refuge Officer	335-3836 (Home) 236-7141 (Mobile)
M-8	Louise Kotarba, Admin. Support	945-8970 (Home)
M-11	William Jones, ORP	492-1104 (Home) 236-7142 (Mobile)
M-15	Annabella Larsen, Wildlife Biologist	945-3019 (Home) 236-7143 (Mobile)
M-9	Frank Buck, Tractor Operator	645-2769 (Home) 590-0616 (Pager) 236-7140 (Mobile)

M-12 George O'Shea, Refuge Operations	684-0220 (Home)
Hal Laskowski, Regional Zone Biologist	410-820-5581 (H) 236-2141 (Mobile) 684-4029 (Fax)
Lamar Gore, Asst Reg. Zone Biologist	684-4423 (Office) 684-0393 (Home)
Laura Mitchell, Regional Fire Biologist	684-5401 (Office) 684-5402 (Fax) 410-208-9073 (H)

EQUIPMENT LIST

Marsh Master II amphibious tractor

Massey Ferguson 1085 tractor

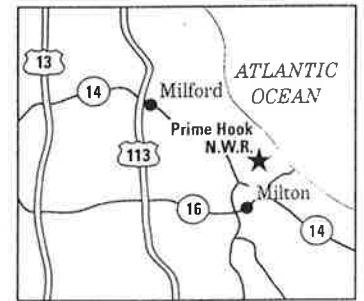
John Deer 3010(?) Tractor

Slip-on tanker (gallons)

Misc. hand tools(list separately?)

Backpack pumpers (number)

Prime Hook National Wildlife Refuge

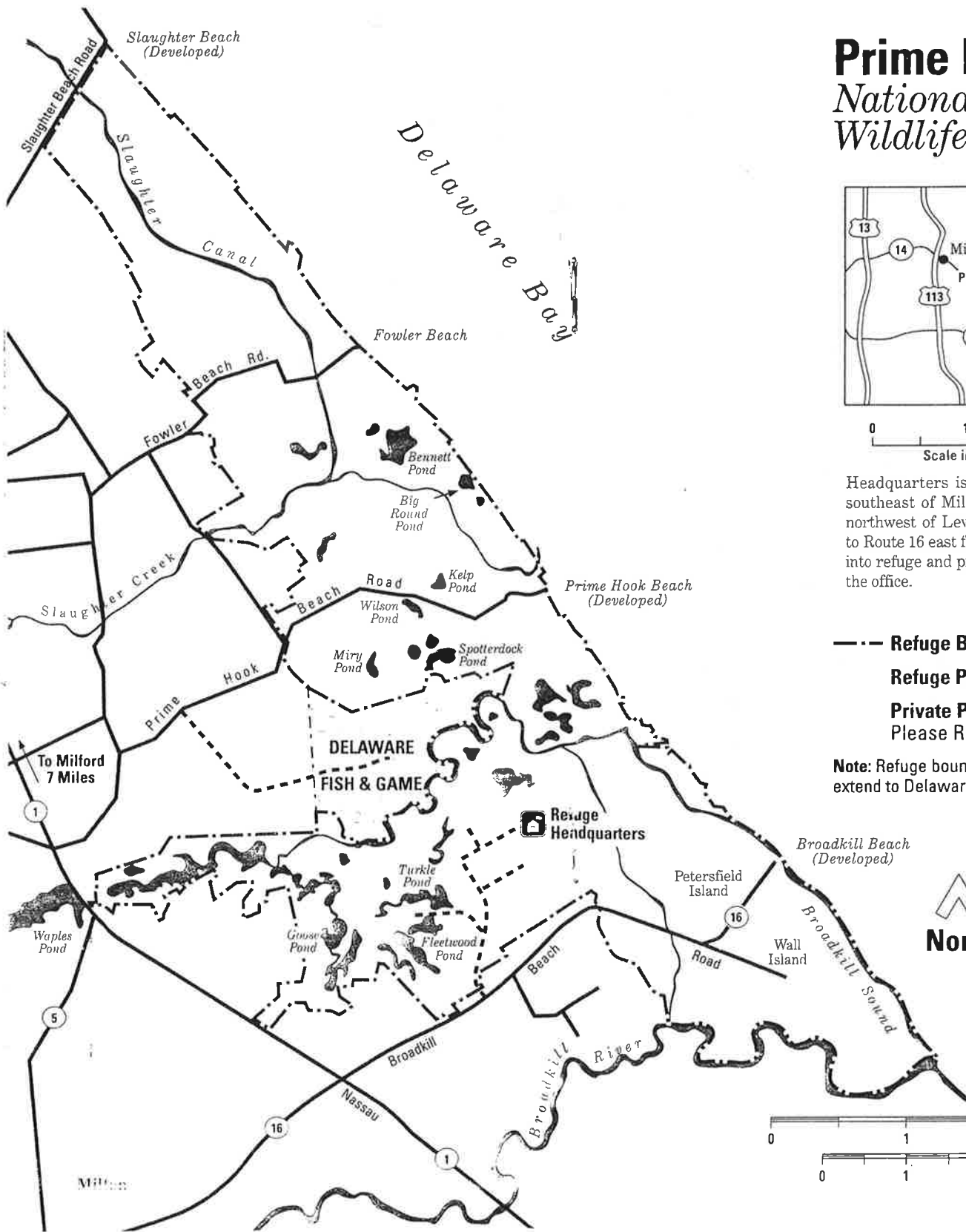


0 10 20
Scale in Miles

Headquarters is located 12 miles southeast of Milford and 10 miles northwest of Lewes. Take Route 1 to Route 16 east for 1 mile. Turn left into refuge and proceed 1.6 miles to the office.

- Refuge Boundary
- Refuge Property
- Private Property
- Please Respect

Note: Refuge boundary does not extend to Delaware Bay.



0 1 2 Miles
0 1 2 Kilometers



Appendix H. Current Refuge Boundaries Map

See back cover.

Year	Weather	Prescribed Burning					Wildfire			
		Acres	Location	Date	Purpose	Acres	Location	Date	Cause	Comments
1972	Very Wet +18.75	-	-	-	-	7	Petersfield Ditch	April	Careless Burning	20 acres burned off refuge
1973	Normal -0.05	-	-	-	-	1 1	PHB Road SB Road	April April	Arson Arson	Marsh grasses Phragmites
1974	Normal +2.74	-	-	-	-	-	-	-	-	-
1976	Dry -8.21	-	-	-	-	-	-	-	-	-
1977	Dry -11.61	-	-	-	-	1000	Unit II	April	Arson	Fire threatened community of PH Beach. Primary firefighting effort was to protect private homes.
1978	N/A	-	-	-	-	-	-	-	-	Work on cooperative agreements begins with Milton and SB fire companies for suppression.
1979	Wet +6.92	-	-	-	-	<1	PHB Road	March	Unknown	Work on cooperative agreements continues.
1980	Dry -4.33	-	-	-	-	~2	?	Feb-April	Arson	5 Fires occurred all less than .5 acres. Borrowed track vehicle used to create a 1.5 mile long by 150' firebreak adjacent to private homes on marsh edge. Cooperative agreements not yet in place.

Year	Weather	Prescribed Burning					Wildfire				
		Acres	Location	Date	Purpose	Acres	Location	Date	Cause	Comments	
1981	Dry -7.22	600-800	Unit I	Feb	Fuel Reduction	1	PHB Road	Jan	Unattended burn	Memorial Fire Dept. assisted in prescribed burn.	
1982	Normal -2.35	-	-	-	-	-	-	-	-		
1983	Wet +13.5	-	-	-	-	1	?	?	Arson	Phragmites was the vegetation type burned.	
1984	Normal +2.08	-	-	-	-	-	-	-	-	Fire Management Plan completed and submitted.	
1985	Normal -1.19	60	Unit IV	Mar-28	Phragmites	.1	Unit IV	Mar-17	Cigarette	November wildfire threatened homes and personnel on PHB. Cooperative agreements with Milton Fire Dept Inc. and Memorial Volunteer Fire Company in Slaughter Beach.	
		300	Unit I	Mar-30	Phragmites	1.2	Unit IV	Mar-21	Unknown		
		30	Unit IV	Apr-4	Marsh grass	100	Unit IV	Mar-28	Escaped RX Fire		
						960	Unit II	Nov-3	Arson		
1986	Dry -10.49	35	Goose Pond	Mar-24	Understory	500	Unit I	Mar-26	Unknown	-	
		150	Unit IV	Mar-27	Marsh grass	1	?	Sep-14	Cigarette		
1987	Dry -6.27	100 100	Unit IV Unit IV	Mar-23 Mar-24	Marsh grass Upland grass	.5	Unit II	Mar-20	Arson	-	

Year	Weather	Prescribed Burning					Wildfire			
		Acres	Location	Date	Purpose	Acres	Location	Date	Cause	Comments
1988	Normal +1.73	75	Unit I	Mar-9	Phragmites	-	-	-	-	-
		830	Unit I	Mar-22	Phragmites					
		150	Unit I	Mar-22	Upland grass					
		125	Unit IV	Mar-29	Marsh grass					
		50	Unit I	Mar-31	Upland grass					
		55	Unit III	Apr-06	Upland grass					
1989	Wet +7.59	-	-	-	-	-	-	-	-	-
1990	Wet +10.06	-	-	-	-	4.5	Unit I	Mar-13	Careless burning	-
1991	Normal +2.86	-	-	-	-	250	Unit I	Mar-12	Escaped RX fire	???No Rx this year
						6	Unit I	Apr-10	Arson	
						2	Unit I	Apr-11	Arson	
1992	Normal +2.49	-	-	-	-	1	Unit I-FB	Apr-11	Arson	
						3	Unit I-FB	May-11	Arson	
1993	Wet +9.96	-	-	-	-	1	Unit II	Jan-16	Arson	
1994	Wet +14.61	-	-	-	-	1	FB Road	Mar-8	Arson	
						.5	FB Road	Apr-9	Arson	
						1.5	FB Road	May-11	Arson	

[illegible]

Appendix J. Wildlife Species known to occur at Prime Hook National Wildlife Refuge

Mammals

beaver, *Castor canadensis*
big brown bat, *Eptesicus fuscus*
coyote, *Canis latrans*
Delmarva Peninsula fox squirrel, *S. niger cinereus*
eastern pipistrelle, *Pipistrellus subflavus*
eastern cottontail, *Sylvilagus floridanus*
eastern mole, *Scalopus aquaticus*
eastern gray squirrel, *Sciurus carolinensis*
gray fox, *Urocyon cinereoargenteus*
hoary bat, *Lasiurus cinereus*
house mouse, *Mus musculus*
little brown bat, *Myotis lucifugus*
least shrew, *Cryptotis parva*
longtail weasel, *Mustela frenata*
marsh rice-rat, *Oryzomys palustris*
masked shrew, *Sorex cinereus*
meadow flying mouse, *Zapus hudsonius*
meadow vole, *Microtus pennsylvanicus*
mink, *Mustela vison*
muskrat, *Ondatra zibethica*
northern shorttail shrew, *Blarina brevicauda*
Norway rat, *Rattus norvegicus*
nutria, *Myocastor coypus*
opossum, *Didelphis virginiana*
otter, *Lutra canadensis*
raccoon, *Procyon lotor*
red bat, *Lasiurus borealis*
red fox, *Vulpes fulva*
silver-haired bat, *Lasionycteris noctivagans*
southern flying squirrel, *Glaucomys volans*

starnose mole, *Condylura cristata* l
striped skunk, *Mephitis mephitis*
white-footed mouse, *Peromyscus leucopus*
white-tailed deer, *Odocoileus virginianus*
woodchuck, *Marmota monax*
woodland or pine vole, *Microtus pinetorum*

Amphibians and Reptiles, See Bombay NWR guide located in back cover.

Interim bird list of
Prime hook nwr

Produced by

The Friends of Prime Hook, NWR
11978 Turtle Pond Road
Milton, DE 19968

s S F W

LOONS - GREBES

___ Red-throated Loon	.....	r	r	r	r
___ Common Loon		r.....			
___ *Pied-billed Grebe	.....		o	o	u . o
___ Horned Grebe	o	o	u		

PELICANS - CORMORANTS

___ Brown Pelican	.....r.....				
___ Double-crested Cormorant		c	c	c	u

BITTERNS - HERONS - IBISES

___ American Bittern	o	u	u	o	
___ *Least Bittern	u	u	u.....		
___ Great Blue Heron	c	c	a	u	
___ Great Egret	u	a	c	r	
___ Snowy Egret	c	a	c	r	
___ Little Blue Heron	o	u	u.....		
___ Tricolored Heron	o	u	o.....		
___ Cattle Egret	o	u	o.....		
___ *Green Heron	c	c	c.....		
___ Black-crowned Night-Heron		u	u	u	r
___ Yellow-crowned Night-Heron		r.....r.....			
___ Glossy Ibis	c	c	u	r	

SWANS - GEESE - DUCKS

___ Fulvous Whistling-Duck	r	r	r.....		
___ Tundra Swan	o		u	u	
___ *Mute Swan	u	u	u	o	
___ Greater White-fronted Goose			r		r
___ Snow Goose	u	r	a	a	
___ Ross' Goose		r.....r			
___ Brant				r	
___ *Canada Goose	a	c	a	a	
___ *Wood Duck	c	c	a	o	
___ Green-winged Teal	a	o	a	a	
___ *American Black Duck	c	c	a	a	
___ *Mallard	a	c	a	a	
___ Northern Pintail	a	r	a	a	
___ Blue-winged Teal		c	o	c	r
___ Northern Shoveler		c		u	c
___ *Gadwall	c	a	a	u	
___ Eurasian Wigeon			r	r.....	
___ American Wigeon		c	o	c	c

			<u>s</u>	<u>S</u>	<u>F</u>	<u>W</u>
___ Canvasback			o			
___ Redhead	r		r			
___ Ring-necked Duck	.....		o	....	u	u
___ Greater Scaup	u		u	u		
___ Lesser Scaup	u		u	u		
___ Long-tailed Duck (Oldsquaw)					r	r
___ Black Scoter	o		o	o		
___ Surf Scoter	o	.	o	o		
___ White-winged Scoter		.....	u.....			
___ Common Goldeneye		o		o	o	
___ Bufflehead	u		u	u		
___ *Hooded Merganser		u	o	u	c	
___ Common Merganser	.....				o	o
___ Red-breasted Merganser				u	u	.
___ Ruddy Duck	u	u				

VULTURES - HAWKS - FALCONS

___ *Black Vulture	u	u	u	u		
___ *Turkey Vulture	c	c	c	c		
___ *Osprey	c	c	o.....			
___ *Bald Eagle	.....			u	u	. u . u
___ Northern Harrier	c	o	c	c		
___ Sharp-shinned Hawk		o	o	u	o	
___ *Cooper's Hawk	o	r	u	o		
___ *Red-shouldered Hawk		o	o	o	o	
___ *Red-tailed Hawk	u	u	c	c		
___ Rough-legged Hawk		o		o	o	
___ Golden Eagle			r	r		
___ *American Kestrel	u	u	c	c		
___ Merlin	r	o	r			
___ Peregrine Falcon	u		u	r		

GROUSE - QUAIL - TURKEY

___ *Ring-necked Pheasant		u	u	u	u	
___ *Wild Turkey	u	u	u	u		
___ *Northern Bobwhite	u	u	u	u		

RAILS - COOTS

___ *Black Rail	r	r	r.....			
___ *Clapper Rail		u	u	u	u	
___ *King Rail	u	u	u	u		
___ *Virginia Rail		u	u	u	o	
___ Sora	u	u	u.....			
___ *Common Moorhen	o	o	o.....			
___ *American Coot	o	o	o	c		

PLOVERS - SANDPIPERS

___ Black-bellied Plover	u	u	u	r		
___ Lesser Golden-Plover		o	r	o.....		
___ Semipalmated Plover		c	u	c	r	
___ *Killdeer	c	c	c	u		
___ *Black-necked Stilt	u	c	o.....			
___ Greater Yellowlegs	c	c	c	o		
___ Lesser Yellowlegs	c	c	c	o		
___ Solitary Sandpiper	o		o.....			
___ *Willet	a	a	o.....			

___ *Spotted Sandpiper	u	o	u.....				
				<u>s</u>	<u>S</u>	<u>F</u>	<u>W</u>
___ Hudsonian Godwit			r.....				
___ Ruddy Turnstone	c	c	u	u			
___ Red Knot	a	o	o.....				
___ Sanderling	a	o	o.....				
___ Semipalmated Sandpiper		a	o	a.....			
___ Western Sandpiper	c	o	c	.			
___ Least Sandpiper	c	c	c	.			
___ White-rumped Sandpiper		o	o	o.....			
___ Pectoral Sandpiper	o	u	u.....				
___ Dunlin	a	o	a	u			
___ Stilt Sandpiper	u	u	u.....				
___ Ruff	r		r.....				
___ Short-billed Dowitcher		c	u	u		r	
___ Long-billed Dowitcher			o	o.....			
___ Common Snipe	c	o	o	u			
___ *American Woodcock		c	u	c		r	
___ Wilson's Phalarope	o		o.....				
___ Red-necked Phalarope		r.....					

GULLS - TERNS

___ Laughing Gull	a	a	a.....				
___ Bonaparte's Gull	o	o	o.....				
___ Ring-billed Gull	c	u	a	c			
___ Herring Gull	c	c	c	c			
___ Great Black-backed Gull		c	c	c	c		
___ Caspian Tern	o	u	u.....				
___ Royal Tern	c	o	c.....				
___ Common Tern		o	o	o.....			
___ Forster's Tern		c	c	c.....			
___ Least Tern	u	u.....u					
___ Black Tern	r	r	r.....				
___ Black Skimmer	r	r	r.....				

DOVES - PARROTS - CUCKOOS - OWLS

SWIFTS - HUMMINGBIRDS

___ *Rock Dove				u	u	. u	. u
___ *Mourning Dove	c	a	a	c			
___ *Black-billed Cuckoo		o	o	o.....			
___ *Yellow-billed Cuckoo		u	u	u.....			
___ *Barn Owl	u	u	u	u			
___ *Eastern Screech-Owl		u	u	u		u	
___ *Great Horned Owl	c	c	c	c			
___ *Barred Owl	u	u	u.....u				
___ Short-eared Owl	.		u	u			
___ Common Nighthawk				u	u	. u.....	
___ Chuck-will's widow	c	c	o.....				
___ Whip-poor-will	u	u.....					
___ Chimney Swift	c	c	c.....				
___ *Ruby-throated Hummingbird			c	c		c.....	
___ *Belted Kingfisher	u	u	u	o			

WOODPECKERS - FLYCATCHERS

___ Red-headed Woodpecker	r		r	r			
---------------------------	---	--	---	---	--	--	--

___ *Red-bellied Woodpecker	c	c	c	c
___ Yellow-bellied Sapsucker	u		u	r
___ *Downy Woodpecker	c	c	c.....	
			<u>s</u> <u>S</u> <u>F</u> <u>W</u>	

___ *Hairy Woodpecker	u	u	u	u
___ *Northern Flicker	c	c	c	o
___ Pileated Woodpecker		r.....f.....f.....f		
___ *Eastern Wood-Pewee		c	c	c.....
___ *Acadian Flycatcher	u	c	o.....	
___ Alder Flycatcher	r	r.....		
___ *Willow Flycatcher	o	u	o.....	
___ Least Flycatcher	o		o.....	
___ *Eastern Phoebe	c	u	c.....	
___ *Great Crested Flycatcher		c	c	c.....
___ *Eastern Kingbird	c	c	c.....	

LARKS - SWALLOWS - JAYS - CROWS

___ *Horned Lark	u	u	u	u
___ *Purple Martin	c	c	o.....	
___ *Tree Swallow	c	a	a	r
___ Northern Rough-winged Swallow			u	o u.....
___ *Bank Swallow	o	c	c.....	
___ *Barn Swallow	c	c	c	r
___ *Blue Jay	c	c	c	c
___ *American Crow		c	a	a c
___ *Fish Crow	c	a	a	o

TITMICE - NUTHATCHES - WRENS

___ *Carolina Chickadee		c	a	c	c
___ *Tufted Titmouse	c		a	c	c
___ Red-breasted Nuthatch		o		u	u
___ White-breasted Nuthatch		u	o	u	u
___ Brown Creeper	u		u	u	
___ *Carolina Wren	c	c	c	c	
___ *House Wren	c	c	c	r	
___ Winter Wren	u		u	u	
___ Sedge Wren		o	r	.	
___ *Marsh Wren	c	a	c	o	

KINGLETS - THRUSHES - THRASHERS

___ Golden-crowned Kinglet		o		u	u
___ Ruby-crowned Kinglet		c		c	o
___ *Blue-gray Gnatcatcher		u	u	o.....	
___ *Eastern Bluebird	u	c	c	u	
___ Veery	u	o	u.....		
___ Gray-Cheeked Thrush		o		o.....	
___ Hermit Thrush	c		c	u	
___ Swainson's Thrush	u		u.....		
___ *Wood Thrush	c	c	c.....		
___ *American Robin	a	a	a	c	
___ *Gray Catbird	c	c	c	o	
___ *Northern Mockingbird	.....	.....	.....	c	c . c . c
___ *Brown Thrasher	c	c	c	o	

WAXWINGS - SHRIKES - STARLINGS

___ American Pipit		o	o	o
--------------------	--	---	---	---

___ *Cedar Waxwing	o	r	o	o
___ Loggerhead Shrike	r		r	r
___ *European Starling	a	a	a	a

s S F W

VIREOS - WOOD WARBLERS

___ *White-eyed Vireo	c	c	c	.	
___ *Solitary Vireo	o		o.....		
___ *Yellow-throated Vireo		o	o	o.....	
___ *Red-eyed Vireo	a	a	a.....		
___ Blue-winged Warbler		o		o.....	
___ Golden-winged Warbler		o		o.....	
___ Tennessee Warbler	o		o.....		
___ Nashville Warbler	o		o.....		
___ Northern Parula	u	o	u.....		
___ *Yellow Warbler	c	c	c.....		
___ Chestnut-sided Warbler		u	o	u.....	
___ Magnolia Warbler	u		u.....		
___ Cape May Warbler	o		o.....		
___ Black-throated Blue Warbler			c		c.....
___ Yellow-rumped Warbler		a		a	c
___ Black-throated Green Warbler			u		u.....
___ Blackburnian Warbler		o		o.....	
___ *Pine Warbler	c	c	u	r	
___ *Prairie Warbler	u	o	o.....		
___ Palm Warbler	u		u	.	
___ Bay-breasted Warbler		u		u.....	
___ Blackpoll Warbler	c		c.....		
___ *Black-and-white Warbler		u	o	c.....	
___ *American Redstart	c	o	c.....		
___ *Yellow-Throated Warbler		u	u	u.....	
___ *Prothonotary Warbler		u	u	u.....	
___ Worm-eating Warbler		o		.....
___ *Ovenbird	c	u	c.....		
___ Northern Waterthrush			c		c.....
___ *Louisiana Waterthrush		o	o	o.....	
___ Kentucky Warbler	u	u	o.....		
___ *Common Yellowthroat		c	c	c	r
___ Hooded Warbler	r	r	r.....		
___ Wilson's Warbler	o		o.....		
___ Canada Warbler	u	o	o.....		
___ *Yellow-breasted Chat		u	u	u	r

TANAGERS - SPARROWS

___ *Summer Tanager	u	u.....			
___ *Scarlet Tanager	c	c	c.....		
___ *Northern Cardinal	c	c	c	c	
___ Rose-breasted Grosbeak		o		o.....	
___ *Blue Grosbeak	c	c	u.....		
___ *Indigo Bunting	c	c	u.....		
___ Snow Bunting			o	u	
___ *Rufous-Sided Towhee				c	c . c . o
___ American Tree Sparrow		o		u	u
___ *Chipping Sparrow	u	u	u	r	
___ *Field Sparrow	c	c	c	u	
___ Lark Sparrow	r.....				

___ Savannah Sparrow	c	r	c	c		
___ Henslow's Sparrow			r.....			
___ *Saltmarsh Sharp-tailed Sparrow			c	c	c	o
___ *Seaside Sparrow	a	a	a	o		
___ Fox Sparrow	o		u	u		

s S F W

___ Vesper Sparrow	r.....					
___ *Song Sparrow	c	c	c	c		
___ *Swamp Sparrow	c	a	c	c		
___ White-throated Sparrow		a		a	a	
___ White-crowned Sparrow		u		u	u	
___ Dark-eyed Junco	c		c	c		
___ Lapland Longspur				r		

BLACKBIRDS -FINCHES

___ Bobolink	u		u.....			
___ Red-winged Blackbird		a	a	a	a	
___ *Eastern Meadowlark		u	u	u	u	
___ Rusty Blackbird	u		u	u		
___ *Boat-tailed Grackle		u	u	u	u	
___ *Common Grackle	a	c	a	c		
___ *Brown-headed Cowbird		c	c	c	c	
___ *Orchard Oriole	c	c	o.....			
___ Northern Oriole	u	u	u.....			
___ Purple Finch	u		o	r		
___ *House Finch	c	c	c	c		
___ Common Redpoll			r	r		
___ Pine Siskin	r		r			
___ *American Goldfinch		c	c	c	c	
___ Evening Grosbeak	r		r	r		
___ *House Sparrow	u	u	u	u		

KEY:

a	abundant - A numerous species	<u>s</u>	Spring	March - May
c	common - Often seen or heard in suitable habitat	<u>S</u>	Summer	June - August
u	uncommon - Present, but not certain to be seen	<u>F</u>	Fall	Sept - Nov
o	occasional - Seen only a few times during a season	<u>W</u>	Winter	Dec - Feb
r	rare - May be present, but not every year			
*	Indicates a nesting species			

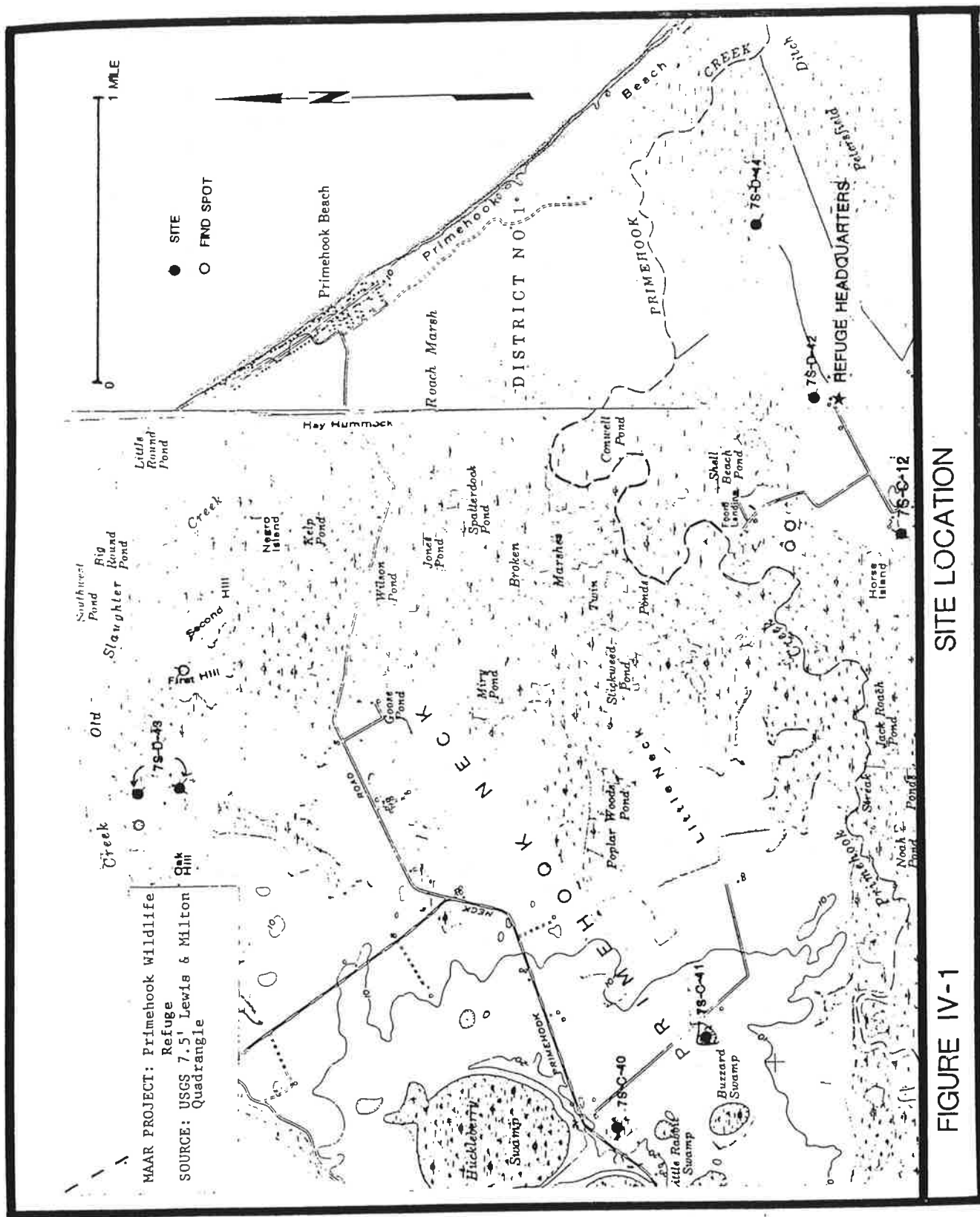
The '*Friends*' thank the following folks for their input and appreciate the generous donation of their time spent developing this Bird List:

Bill Fintel, (Avian Aquatics & Sussex Bird Club)
Liz & Lew Dumont, (Sussex Bird Club)
Sally Fintel, (Sussex Bird Club)
George O'Shea, Compiling List (PHNWR Staff & Sussex Bird Club)

Recognizing that bird populations and habitats are constantly changing, we welcome further input from Birders.
Please send comments to Charles Darling or George O'Shea in care of Prime Hook NWR.

Document: BIRDLISTPRIMEHOOK.WP5
9/10/01 cnd, Ver. 0.4

Appendix K. Historical and Cultural Resources Location Map



SITE LOCATION

FIGURE IV-1

Appendix L. Improvements to Refuge Property

Property	Tract	RPI Number	Location	Replacement Cost (in 1000s)	Comments
Old Shop	77a	22	Maintenance	\$78	
Old Pheasant House	77a	25	Maintenance	\$16	Potential Historic Site
Storage	77a	26	Maintenance	\$20	
Pump House	54	189	Headquarters	\$5	
Old Milkhouse	54	191	Headquarters	\$77	
Shop Boat Dock	77a	257	Maintenance	\$28	
Maintenance Shop	77a	271	Maintenance	\$320	
Boardwalk Trail	49, 54	285	Headquarter e	\$150	
Observation Platform	57	305	Pine Grove Trail	\$20	
Environmental Education Pavillion	54	322	Headquarters	\$5	
Aluminum Pole Shed	77a	323	Maintenance	\$41	
Hunt Check-in Station	80	327	Entrance Area	\$10	
Deer Check Station	80	399	Entrance Area	\$27	
Refuge Office/ Visitor Center	54	328	Headquarters	\$650	
Flammable Storage Shed	77a	402	Shop Area	\$16	
Tool Storage	77a	403	Shop Area	\$11	
Storage Shed	77a	418	Shop Area	10	

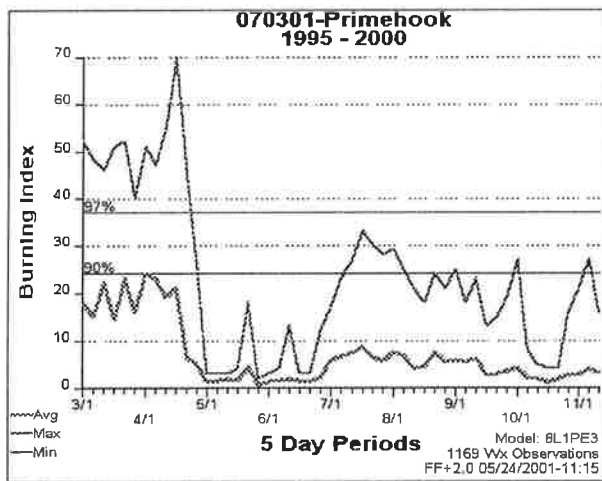
Storage Shed	80	419	Entrance Road	10	
Regional Biologist Trailer	54a	?	Office Area	50	

Appendix M. BI and KBDI Fuel Models L, R, E

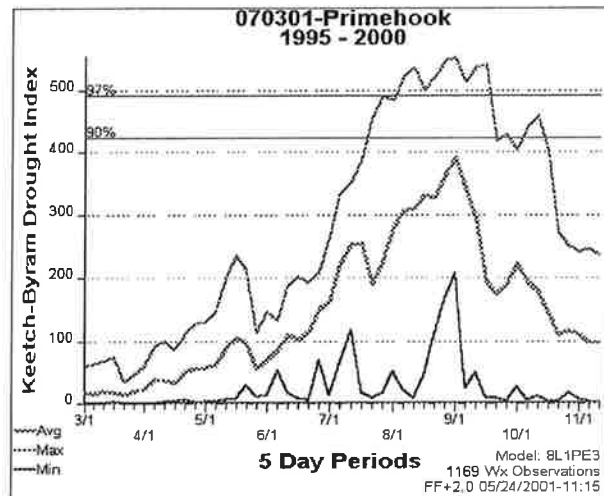
FireFamily Plus and Fire Program Analysis

An overall goal of fire management is to integrate fire with other land management activities to achieve desired objectives at the lowest cost. Understanding how fires are likely to behave given the Refuge's associated weather, topography, and fuel moistures can provide insight in establishing limits for such items as public activities, prescribed fire prescriptions, pre-positioning resources, and selecting appropriate wildfire suppression tactics. FireFamily Plus is a computer program that combines weather station characteristics, daily historical weather records, and NFDRS fuel model information to produce distribution tables and graphs of NFDRS indices and components. Fire managers can then determine staffing class levels (Step-up Plan) based on increasing fire danger, and establish a cost efficient fire program. The fuel model and indices used for the step-up plan at Bombay Hook NWR are found in section III Wildland Fire Management Program

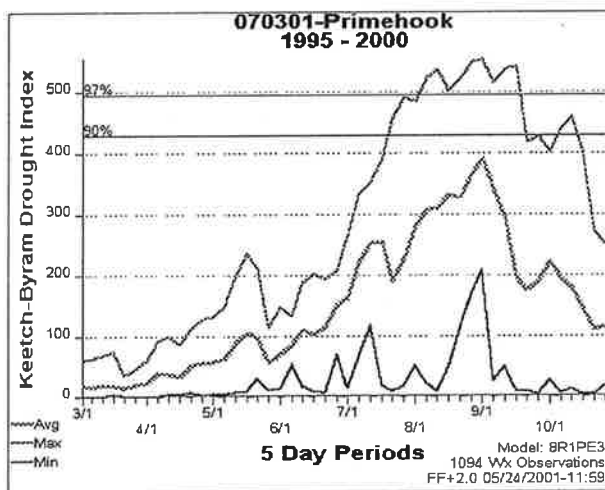
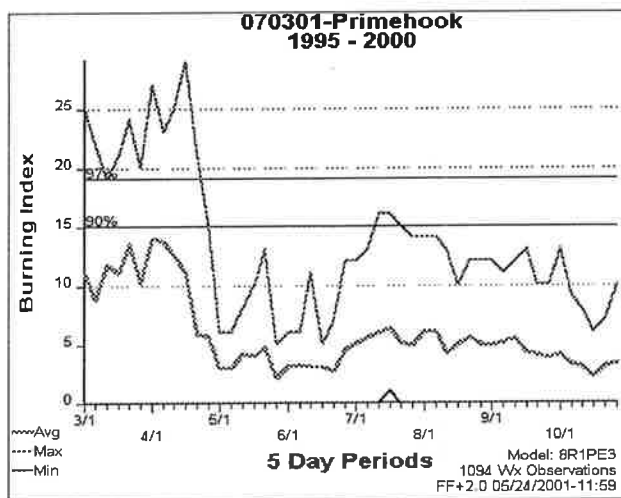
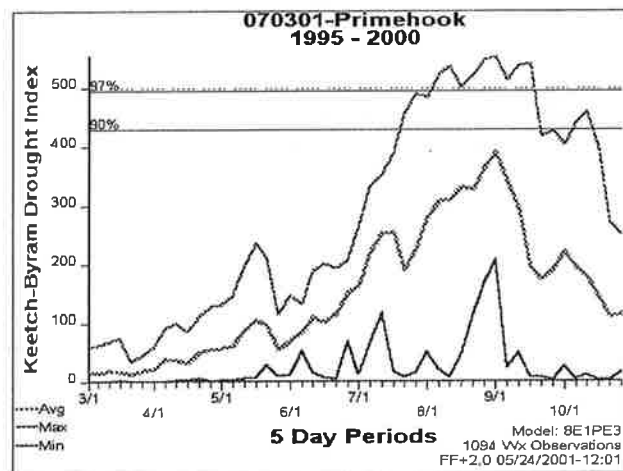
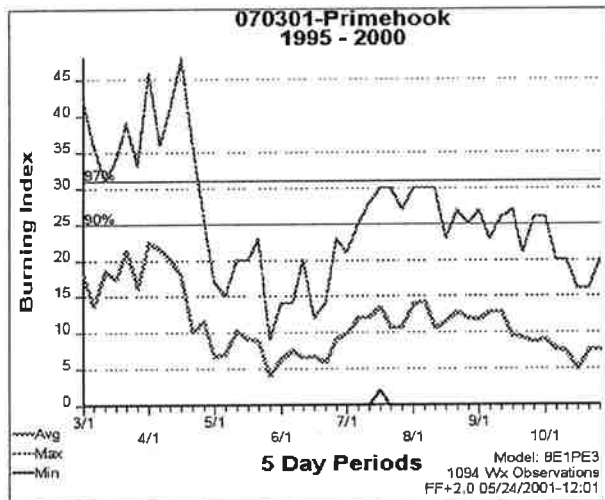
The graphs below are for the other fuel models found on the refuge. The left column shows the normal (average) BI throughout the defined fire season, and the right column shows the KBDI values. Note the 90th and 97th values, which serve as trigger points in the Refuge Step-up Plan for fuel model N defined above in III, A, b.



BI



KBDI



Appendix N. Normal Unit Strength Inventory

Normal unit strength (NUS) is the amount of non-capitalized fire fighting equipment needed by a refuge to met 70% of supression needs. Additional capitalized equipment is crucial to normal suppression activities at Prime Hook National Wildlife Refuge. Most refuge fires will be controlled by local fire departments under a Memorandum of Understanding. The following lists equipment needs for refuge staff to perform prescriptive burns and assist local fire departments in controlling wildfire on refuge.

Personal Protective Equipment

Item	In Stock	Needed
Nomex Fire Shirts	3	15
Nomex Fire Pants	3	15
Fire Shelters with Case	12	0
Hard hats-Fire line-approved	12	0
Leather Fire Gloves	5	15
Canteens- 1qu. disposable w/ case	3	5
Earplugs- disposable	50	0
Headlamps	10	0
Goggles	5	5
Day Pack w/ Harness	5	3
Personal 1 st Aid Kit	15	0

Hand Tools

Item	In Stock	Needed
Fire Shovels	10	0
Pulaskis	2	0
Council Rakes	10	0
McCleod Rakes	2	0
Combi Tools	2	0
Flapper Tools	2	0
Drip Torches	2	0
Backpack Pumps	3	5

Fuel Cans-5 gal. safety cans	2	0
10-Person equipment cache at coop fire depts	0	2

Non-capitalized Power Equipment

Item	In Stock	Needed	Comments
Chainsaw Kits	0	2	
Power Brush Cutter	3	0	
Leaf Blower	2	0	
Fuel cans, 2 compartment safety cans	1	0	
Drip torch fuel in 5 gallon safety	1	0	
Pump Fuel in 5 gallon safety can	N/A		
Chainsaw fuel, in 2.5 gallon safety can	2	0	
1.5" rubber suction hose, 10' lengths	15	0	
First Aid Kit, 10 person	0	1	

Communication Equipment

Item	In Stock	Needed	Comments
Handheld Portable Radios	3	?	State owned. No Nat'l fire radios
Cellular portable telephones	5	0	
Personal pagers	0	0	

Appendix O. Step-up staffing classes for Prime Hook NWR

Step-up Staffing class		
Staffing Class	Burning Index	Actions
I (Low)	0-30	<p>Prevention - Prevention activities can be grouped into two categories: Refuge activities; and coordination with other agencies. During low fire danger situations, Refuge activities will represent the major prevention activities. Visitors, should use public use areas only; no open fires and to totally refrain from the use of any fireworks or explosives.</p> <p>Detection - Refuge personnel will carry out normally assigned duties.</p> <p>Preparedness - Refuge personnel will carry out normally assigned duties.</p>
II (Moderate)	40-60	<p>Prevention - Refuge actions described above under conditions of low fire danger will be sufficient for conditions of moderate fire danger. No additional Refuge actions or coordination with other agencies are necessary.</p> <p>Detection - Personnel to carry out normally assigned duties.</p> <p>Preparedness - A minimum of one slip-on pump unit for the Refuge will be prepared for operation. Fire suppression tools will be added to Refuge vehicles involved in field operations.</p>
III (High)	70-80	<p>Prevention - In addition to the steps to be taken during periods of low and moderate fire danger, visitors will be warned of the level of fire danger and restrictions will be implemented against any smoking in the Refuge's back country. Refuge activities may include notification of local cooperators of increasing fire danger.</p> <p>Detection - Personnel to carry out normally assigned field duties with special emphasis on fire detection.</p> <p>Preparedness - Fire suppression tools will be added to all Refuge vehicles. A minimum of one slip-on pump unit will be installed and made operable in pick-up truck. Each equipped vehicle will carry sufficient tools and supplies to sustain initial attack until first reinforcements can arrive on a fire.</p>
IV (Very High)	90-100	<p>Prevention - All previously mentioned prevention activities would be conducted. In addition, Refuge activities will be stepped-up to include notification of local and regional cooperators. Coordination with other agencies will increase in terms of both short and long range planning, public notification, coordinated prevention activities, and increased cooperation.</p> <p>Detection - Refuge personnel will carry on normally assigned detection duties. FMO may designate one or more personnel to part or fulltime road patrol. Patrols may be increased at the discretion of the FMO or RFMC.</p> <p>Preparedness - All available slip-on pumps will be placed on appropriate Refuge vehicles and made fire-suppression ready; i.e., in working condition, water tanks full, etc. All appropriate Refuge vehicles will be stocked with initial attack fire-tools and supplies. All Refuge personnel qualified and assigned fire suppression duties will be placed on one-hour call-up notice. Notice will be forwarded to the neighboring offices and Regional Office of the very high fire danger condition. Daily availability of additional local, regional, and national resources will be monitored.</p>
V (Extreme)	110+	<p>Prevention - In addition to all steps detailed above, visitors to the Refuge will be orally warned of the fire danger conditions, and no open fires will be permitted. Refuge activities will be continually ongoing through Refuge personnel or cooperators' efforts. Daily notification of Regional Office FMO will be completed to enable public notification from that office. Cooperators will be continually updated in regard to conditions and opportunities for bans on open burning or related activities.</p> <p>Detection - Fire patrols will be increased in the number of personnel patrolling, in the frequency and in the extent of these patrols. Specially placed lookouts may be ordered as the conditions warrant, at the discretion of the FMO.</p> <p>Preparedness - In addition to preparedness steps taken for low-moderate-high-very high fire danger conditions, The Regional Office will be kept informed of current conditions. The locations of all work crews will be monitored and all fire suppression personnel will be kept on a 15-minute call-up notice. Daily situation reports will reflect the fire danger situation. Neighboring FMOs, cooperators, and other organizations will be updated periodically regarding the situation. Consideration will be given to pre-positioning additional local or regional suppression resources to supplement suppression capabilities. Fire information will be provided daily to visitors, cooperators, Regional Office, and local media. Refuge fire staff will be on standby and Project Leader or Acting will be available.</p>

Appendix P. Prescribed Fire Plan Format

Prescribed Fire Plan
Prime Hook National Wildlife Refuge

Prepared By: _____

Date: _____

Reviewed By: _____
Regional Fire Management Coordinator

Date: _____

Reviewed By: _____
Refuge Biologist

Date: _____

Reviewed By: _____
Burn Boss
(If not preparer of fire plan)

Date: _____

Approved By: _____
Refuge Manager

Date: _____

The approved Prescribed Fire Plan constitutes the authority to burn, pending approval of Section 7 Consultations, Environmental Assessments, or other required documents. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Prescribed burning conditions established in the plan are firm limits. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported, but personnel will be held accountable for actions taken which are not in compliance with the approved plan.

Prime Hook National Wildlife Refuge

Name of Area:

Acres To Be Burned:

Legal Description:

State: County:

Latitude: Longitude:

Township: Range: Sections:

Quad Map: USGS - Series: 7.5" Scale: 1:24000

Is a Section 7 Consultation being forwarded to Fish and Wildlife Enhancement for review?
YES / NO

Prescribed Fire Burn Boss/Specialist participated in the development of this plan? **YES / NO**

(Included: Refuge maps showing the location of the burn, burn unit, and adjacent areas.)

I. GENERAL DESCRIPTION OF BURN UNIT

Physical Features and Vegetation Cover Types (Species, height, density, etc.):

Elevation: Slope: Aspect:

Unit Description:

Vegetation:

Primary Resource Goals of Unit: (Be specific. These are management goals):

Objectives of Fire (Be specific. These are different than management goals) **and Acceptable**

Range of Results: (Area burned vs. unburned, scorch height, percent kill of a species, range of litter removed)

General Objectives:

- 1) Provide for Firefighter and Public Safety.
- 2) Minimize smoke impacts

Resource Objectives and Ranges:

- 1) *Example* - Reduce or consume 1 hr fuels (grass); 60 - 100%

II. PRE-BURN MONITORING

Vegetation Type	Acres	%	FBPS Fuel Model
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
Total	_____	_____	

Habitat Conditions: (Identify with transect numbers if more than one in burn unit.)

Type of Transects:

Photo Documentation (Add enough spaces here to put a pre-burn photo showing the habitat condition or problem you are using fire to change/correct. A photo along your transect may reflect your transect data.):

III. PLANNING AND ACTIONS

Complexity Analysis Results:(see attached complexity sheet; EXCEL)

Prescribed Fire Organization: (See Section VII, Crew and Equipment Assignments. All personnel and their assignments must be listed. All personnel must be qualified for the positions they will fill.)

Site preparation:

Who: Time:

Fire crew 1-2 weeks prior to burn

What to be done:

Weather information required:

Instrument Location and Elevation (s): On site (wx kit)

Data Collected and Sampling Period: Temp, RH, Wind Speed and direction(mid flame). On site will be 1 day prior to burn.

Forecasts: Weather forecasts(general) will be monitored 2 - 3 days prior to burning. A general (for Low complexity burns only)or spot weather forecast will be requested for the day of the burn or as needed. Forecast obtained from the local Fire Weather Unit:

Local Fire Weather or National Weather Service Office

Safety considerations and Protection of sensitive features:

(Adjacent lands, visitors, facilities, terrain, etc., and needed actions. Include buffer and safety zones. Be specific, indicate on a burn unit map. Map should be a USGS quadrangle if possible, so ridges, washes, water, trails, etc. can be identified.)

General:

Special Constraints and Considerations (Should be discussed with Burn Boss):

Special Safety Precautions Needing Attention:(Aerial ignition, aircraft, ignition from boat, etc.):

Public safety: The area is in a closed part of the refuge.

Safety Zones and Escape Routes: All areas will be identified in the pre-fire briefing.

Medical Facility: Minor injuries will be handled at the scene. Major injuries - call 911 from cell phone (burn Boss). At least 1 First aid trained person will be on scene.

Adjacent Lands:

Facilities:

Endangered, Threatened, or Listed Species:

PROTECTION ACTIONS:

Sensitive or Species of Concern:

PROTECTION ACTIONS:

Archeological, Historical, or Cultural Areas:

PROTECTION ACTIONS:

COMMUNICATION:

Communication and Coordination on the Burn (Who will have radios, frequencies to be used, who will coordinate various activities.):

All crews will have at least 1 radio or be teamed with a person with a radio. Tactical channel **radio Frequencies** Cell phone will be on site and with the Burn Boss or Deputy

Media Contacts (Radio stations, newspaper, etc., list with

telephone numbers): Adjacent land owners and neighbors will be notified prior to the burn.

Burn information is available by request(in person or by phone)from the Prime Hook National Wildlife Refuge Headquarters or contact center:

Phone: 302-684-8419 Fax:302-684-8504

Hrs: Mon - Fri 8:00 am to 4:00 pm

IV. IGNITION, BURNING AND CONTROL

Prime Hook NWR

Scheduling: Approx. Date(s):

Duration: days

Acceptable Range

FBPS Fuel Model_	MIN	MAX	OPT
Temperature (degrees F)			
Relative Humidity (%)			
20' Wind Speed (mph)			
MF Wind Speed (mph) Gusts			
Wind Direction			
Cloud Cover (%)			
ENVIRONMENTAL CONDITIONS			
1 hr. Fuel Moisture			
10 hr. FM			
100 hr. FM			
Woody Live Fuel Moisture			
Herb. Live Fuel Moisture			
FIRE BEHAVIOR			
Rate of Spread (mph): Head fire Backing fire			
Flame Length(feet) Head fire Backing fire			

Cumulative effects of weather and drought on fire behavior: None

Ignition Technique: (Explain and include on map of burn unit. Use of aerial ignition must be identified in this plan. Last minute changes to use aircraft will not be allowed and will be considered a major change to the plan. This will require a resubmission):

Other: (If portions of the burn unit must be burned under conditions slightly different than stated above, i.e., a different wind direction to keep smoke off of a highway or off of the neighbors wash, detail here.)

Prescription monitoring: (Discuss monitoring procedure and frequency to determine if conditions for the burn are within prescription)

V. SMOKE MANAGEMENT

Make any Smoke Management Plan an attachment.

Permits required:(who, when)

Permit required from New Jersey State Forest Fire Service.

Burn will be conducted on a declared "burn day" or as planned under a favorable 48 and 24 hour smoke forecast from the National Weather Service.

Total Emissions Estimate(Tons/# of acres): FOFEM Generated

PM 10:

PM 2.5:

Distance and Direction from Smoke Sensitive Area(s):

Visibility Hazard(s) (Roads, airports, etc.):

Actions to Reduce Visibility Hazard(s):

Residual Smoke Problems: 100% mop-up of the unit after ignition and burn down is completed. No more than 24 hours for any smoke in unit.

Necessary Transport Wind Direction, Speed and Mixing Height: (Explain how this information will be obtained and used)

VI. FUNDING AND PERSONNEL

Activity Code:

Est Costs:

VII. BURN-DAY ACTIVITIES

Public/Media Contacts on Burn Day: (List with telephone numbers):

Crew & Equipment Assignments: (List all personnel, equipment needed, and assignments. The following is not an all-inclusive list for what you may need.)

Crew Briefing Points: Area / unit overview, burn objectives, safety including escape and safety zones, weather, fire behavior, crew assignments, firing pattern and timing, holding concerns, communication, and contingency actions and responsibilities.

Firing Procedures: (Methods, how, where, who, and sequence. Go over what was submitted in Section IV and any changes needed for the present conditions. Attach ignition sequencing map if necessary)

Personnel Escape Plan:

Special Safety Requirements:

Go-No-Go Checklist:

Holding Actions: (crew placement, duties)

Critical Control Problems:

Water Refill Points:

Contingency Plan:(Are there crews standing by to initial attack or will people doing other jobs be called upon to do initial attack, who must be called in case of an escape, what radio frequencies will be used, etc.).

In the event of an escape or conditions become unfavorable(smoke, weather, fire behavior, and/or objectives not being achieved)the Burn Boss will declare the fire out of prescription or escaped(which ever is the situation)and will assume IC of the fire(until relieved by a higher rated

IC). All new burning will stop unless needed to contain the RX or escaped fire. The holding crew will begin attacking the escape and the ignition crew will hold and work the RX fire until the RX fire is contained or is deemed as no threat.

If the fire exceeds the capability of the crews on hand a call will be placed for assistance from local resources through the *Add Local Dispatch or Fire Department* Dispatch. The contingency plan will be outlined in the briefing with procedures for activation of the contingency plan. A list of the available resources will be posted with the *Add Local Dispatch or Fire Department* Dispatch which will be the ordering point for the incident. If the escape fire exceeds more than 12 hours, a Wildland Fire Situation Analysis(WFSA) will be completed for the incident.

Minimum required on - site contingency resources and response times: *Add Resources*

Minimum required off - site contingency resources and response times:

1- Type III IC - 1 hr

Add other Resources (Engines, aircraft, etc. with response times)

Mop Up and Patrol: Mop-up will be 100% due to the fuel load. Smoldering heavy fuels will be extinguished. The area will be patrolled by at least 1 crew through the evening and the following days as needed.

Rehabilitation Needs:

Special Problems:

Prime Hook National Wildlife Refuges

GO-NO-GO CHECKLIST

Answer Yes or No to the following:

- ☐ Do you have an APPROVED fire plan?
- ☐ Are ALL fire prescriptions elements met?
- ☐ Are ALL smoke management prescriptions met?
- ☐ Are ALL permits and clearances obtained?
- ☐ Has an area spot weather forecast been OBTAINED and is it FAVORABLE?
- ☐ Are ALL required personnel in the prescribed fire plan on-site?
- ☐ Have ALL personnel been briefed on the prescribed fire plan requirements?
- ☐ Have ALL personnel been briefed on safety hazards, escape routes, and safety zones?
- ☐ Has the contingency planning process adequately considered FUELS ADJACENT TO and in REASONABLE PROXIMITY to the burn unit?
- ☐ Has the availability of ALL contingency resources been checked, and are they available?
- ☐ Are the ON-SITE holding forces adequate for containment under the expected conditions?
- ☐ Have ALL the required notifications been made?
- ☐ Is ALL of the required equipment in place and in working order?
- ☐ In YOUR OPINION, can the prescribed fire meet the planned objectives, be carried out according to the approved plan?

We certify that we have reviewed the burn objectives, we are in agreement that the Prescribed Fire Complexity Analysis is correct, and that ALL of the questions above were answered "YES"?

Refuge Manager

Date

Burn Boss

Date

VIII. CRITIQUE OF BURN

Were burn objectives within acceptable range of results? (Refer to Section I):

What would be done differently to obtain results or get better results?

Was there any deviation from plan? If so, why?

Problems and general comments:

IX. POST-BURN MONITORING

Date: _____ Refuge Burn Number: _____

Length of Time after Burn: _____

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

X. FOLLOW-UP EVALUATION

Date: _____ Refuge Burn Number: _____

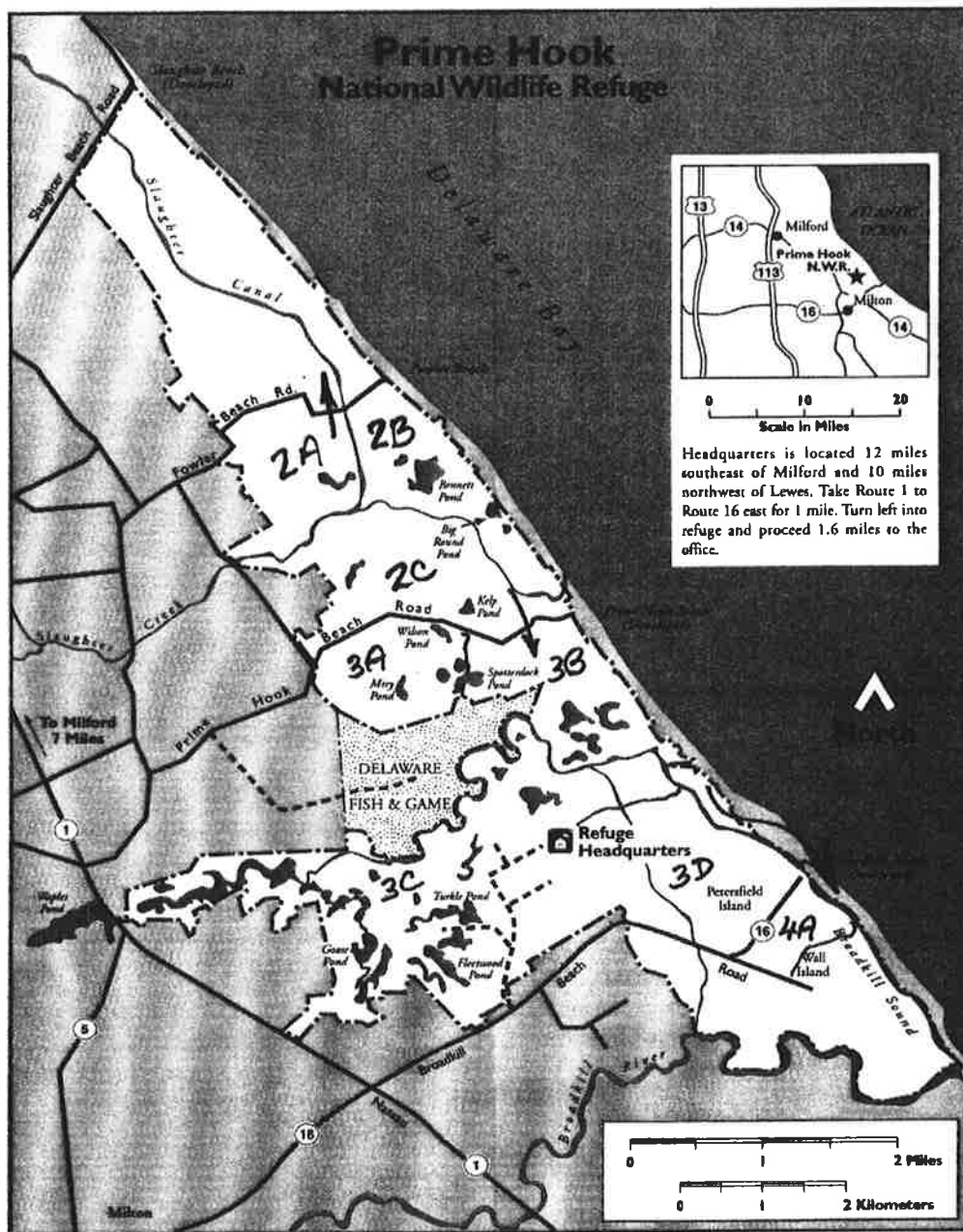
Length of Time after Burn: _____

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Appendix Q. Map Of Fire Management Units



Appendix R. Sample Delegation of Authority

Name of Incident Commander is assigned as Incident Commander of the *Name of Incident*, Prime Hook National Wildlife Refuge for the US Fish and Wildlife, effective *Time and Date*.

The Incident Commander has full authority and responsibility for managing the fire suppression activities within the framework of the law and Fish and Wildlife Service policy and direction as provided by this office. Habitat Management Plans and other appropriate documents will be provided by the Resource Advisor.

Names of Resources Advisors and contact Information are assigned as Resource Advisors. They or the Project Leader will be consulted in situations where natural resource decisions or trade offs are involved unless life safety issues require immediate attention and those actions will be documented.

Specific direction and fire suppression priorities for the *Name of Incident* are as follows, and are in priority order:

1. Provide for firefighter and public safety.
2. Use of minimal impact techniques should be employed to reduce habitat damage. Use natural barriers and roads if possible for burnout operations.
3. Use of dozers or tractors requires approval of the Project Leader or their designate (resource advisors) prior to implementation. *Include other Standards or conditions as needed.*

Turn Back Standards

1. All *Name of Incident* contracts, agreements, bills, medical problems, equipment repairs, and fire cache re-supply shall be closed out prior to team being released.
2. Road damage during suppression efforts will be repaired prior to the teams departure.
3. Fire perimeter mopped-up *Specify* and all lines checked for heat and integrity.
4. Rehabilitation Plan will be completed in Coordination with the Refuge Biologists and resource Advisors.
5. Fire perimeter mapped by GPS and loaded into the Refuges GIS Database.
6. Tort claims reviewed by Project Leader or their designee.

The Deputy Project Leader or Fire Program Manager will represent the Project Leader on any occasion where Project Leader is not immediately available.

Project Leader _____
Prime Hook National Wildlife Refuge
Date and Time.

Appendix S. Environmental Assessment

Finding of No Significant Impact

Based on a review and evaluation of the information contained in the supporting reference enumerated below, I have determined that the project to implement a Fire Management Program at the Prime Hook National Wildlife Refuge, Milton, Delaware is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102 (2) (c) of the National Environmental Policy Act of 1969. Accordingly, preparation of an environmental impact statement of the proposed action is not required.

Supporting Reference

The Environmental Assessment is attached. It summarizes the environmental impacts and the reason why a statement is not required. The assessment is on file at this office and is available for public inspection upon request.

Ma Parker

Regional Director

2/11/02

Date

United States Fish and Wildlife Service

Environmental Action Memorandum

Within the spirit and intent of the Council of Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and have determined that the action of establishment of a Fire Management Plan at Prime Hook National Wildlife Refuge:

- ☐ Is a categorical exclusion as provided by 516 DM 6 Appendix 1. No further documentation will be made.
- ☒ Is found not to have significant environmental effects as determined by the attached Environmental Assessment and Finding of No Significant Impact.
- ☐ Is found to have special environmental conditions as described in the the attached Environmental Assessment. The attached Finding of No Significant Impact will not be final or any actions taken pending a 30-day period for public review (40 CFR 1501.4 (e) (2)).
- ☐ Is found to have significant effects, and therefore a "Notice of Intent" will be published in the Federal Register to prepare an Environmental Impact Statement before the project is considered further.
- ☐ Is denied because of environmental damage, Service policy, or mandate.
- ☐ Is an emergency situation. Only those actions necessary to control the immediate impacts of the emergency will be taken. Other related actions remain subject to NEPA review.

Other supporting documents (list):

MaPanken
Regional Director

2/11/02
Date

(1) Bannon Humphreys
Initiator

1-31-02
Date

(3) W. A. H. A. A.
Regional Env. Coordinator

2/4/02
Date

(2) Joe P. Smith
Refuge Supervisor

2/1/02
Date

(4) Anthony D. Leg.
Regional Chief NWRS

2/8/02
Date

**U.S. DEPARTMENT OF THE INTERIOR
ENVIRONMENTAL ASSESSMENT**

Fire Management Program
Prime Hook National Wildlife Refuge

U.S. Fish and Wildlife Service
Prime Hook NWR

January 2002

Environmental Assessment:
Prime Hook NWR
Fire Management Program

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I. Purpose and Need for Action

A. Introduction

The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge Improvement Act, 1997). This directive supports a two-pronged approach to fire management on National Wildlife Refuges: 1) suppression or pre-suppression of wildfire in order to protect refuge resources from catastrophic fires; and 2) application of prescribed fire for habitat restoration and enhancement.

Prime Hook National Wildlife Refuge (PHNWR) has a need to perform prescribed burning on selected habitats to: perform ecological restoration activities; benefit trust resources and other wildlife; perpetuate ecological processes; and protect human life, property, and natural resources on its land and on adjacent private property.

A Fire Management Plan (FMP) has been prepared in support of the Refuge Fire Management Program. This plan is required by U.S. Department of the Interior policy as stated in the Departmental Manual (620 DM 1) and by U.S. Fish and Wildlife Service (Service) policy as stated in the Fire Management Handbook. Specific wildlife objectives guide the prescribed burning aspects of the Fire Management Plan. The need to protect human life, property, and natural resources will guide the wildfire aspects of the Fire Management Plan (FMP).

This Environmental Assessment explores the various ways prescribed fire and wildfire control can be used to meet interim habitat management objectives and reduce hazardous fuel loads to protect natural and cultural resources, private property, and government structures. These objectives are presented within the guidelines stated by Service policy, and are analyzed in terms of the foreseeable impacts associated with an integrated fire management program.

B. Decisions to Be Made

The objective of this Environmental Assessment (EA) is to decide how to approach the use of prescribed fire and management of wildfire on PHNWR. The responsible official is:

Mr. Barron Crawford

Prime Hook National Wildlife Refuge

11978 Turkle Pond Road

Milton, DE 19968

II. Alternatives Considered

The following definitions are used throughout this document:

Prescribed fire-Fire applied in a scientific way to fuels on a specific land area under selected weather conditions to accomplish predetermined, well-defined management objectives, and identified in an approved Prescribed Fire Plan.

Wildfire- Fire caused by natural means (usually lightning) or human means (e.g., arson, catalytic converter, cigarette, etc.) which is not planned or intended.

Wildland Fire Suppression - All the work of extinguishing or confining a fire, beginning with its discovery.

Wildland Fire Use - Fire which is permitted to burn under specific environmental conditions, in preplanned locations, with adequate fire management personnel and equipment available to achieve resource and hazard fuel reduction objectives.

A. Alternative 1

No Action/Full Suppression

Under this alternative all ignitions, including those of both natural and human-caused origin, would be suppressed and no management prescribed fires would be conducted. Hazard fuel reduction would be accomplished by mechanical and chemical methods to the extent practical and consistent with land management objectives. Hazard fuel reduction would occur in non-sensitive resource areas by mechanical means only. Vegetation/habitat management would be achieved by mechanical means and/or use of herbicides only.

B. Alternative 2

Use of Prescribed Fire and Full Suppression of All Wildfires -

The Proposed Action

Under this alternative, prescribed fires would be used by managers to reduce fuel hazards, achieve resource management objectives, and simulate natural fire processes. All fires would be monitored closely and implemented with a specific number of personnel and equipment to execute necessary actions. No natural ignitions or human caused wildfires would be allowed to burn without suppression.

Prescribed fire will be used to:

- restore early successional vegetation in marsh and upland areas
- restore habitat for declining bird and other wildlife species dependent upon open forest/shrubland/grassland habitats
- assist in eradicating exotic, invasive plants from Refuge lands, including common reed (*Phragmites australis*)
- increase cover of native, warm-season grasses

- provide opportunities for wildlife research and adaptive management
- Reduce the build up of heavy fuels, to reduce the likelihood of a catastrophic wildfire event

Fire hazards around developments and Refuge boundaries would be reduced under this alternative. Suppression would be undertaken on fires that threaten life, property, or resources; or exceed prescription limits. Hazard fuel reduction near houses adjacent to the refuge will be accomplished by mechanical and chemical methods.

Alternative 3

Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

Under this alternative, naturally ignited fires would be allowed to burn in predetermined areas, under favorable environmental conditions. Prescribed fires would be used to reduce fuel hazards and simulate natural processes as described under Alternative 2. Suppression would be undertaken on fires that threaten life, property, resources, or exceed prescription limits.

Dismissed Alternative 4

Allow All Fires to Burn

Under this alternative all ignitions, including those of both natural and human caused origin, would be allowed to burn. This alternative of allowing all fires to burn at all times was initially considered but eventually dismissed as not suitable for further consideration in the development of this proposal. This alternative was rejected because it fails to meet U.S. Fish and Wildlife Service policy in regards to potential liability for losses of life and property, as well as unacceptable environmental, social, and economic costs.

III. Affected Environment

A. Location and History

PHNWR was established under the authority of the Migratory Bird Conservation Act in 1962 for use as an inviolate sanctuary, or any other management purpose, expressly for migratory birds. Today the Refuge's primary objectives continue to focus on providing habitat and protection for waterfowl, waterbirds and other migratory birds, and endangered species; and to insure the availability of these resources to the American people for their enjoyment now and in the future.

PHNWR is located in Sussex County along the southwestern shore of the Delaware Bay. It is within two hours driving time of metropolitan Baltimore, MD, Washington D.C., and Wilmington, DE. The refuge is about 22 miles southeast of state capital of Dover; (population 32,500) and 12 miles north of the resort communities of Lewes, Rehoboth Beach, Cape Henlopen, and Dewey Beach. Historically, the surrounding area has been primarily dominated by agricultural lands. Corn, soybeans, and wheat are the principal cash crops. However, during the 1980's and 1990's, extensive beach development began to become a significant land use, including vacation homes, retirement communities, golf courses, and shopping malls. The eastern boundary of the refuge is adjacent to three beachfront communities: Slaughter Beach, Prime Hook Beach, and Broadkill Beach.

The topography is very flat with almost all of the refuge lying below the 10 foot mean sea level (MSL) contour. Extensive fresh and brackish wetlands, and salt marshes border much of the refuge uplands. The refuge currently comprises about 10,000 acres, of which approximately 75% are wetlands (4,500 acres of impoundments and 2,100 acres of salt marsh). Of the rest of the refuge, 11% are agricultural land, 8% are forested, and 6% are scrub/shrub and grassland, including administrative lands around buildings.

According to Mackenzie et al. (2000), Delaware's Piedmont and coastal plain ecosystems have endured a long history of disruption by human activities. Delaware has experienced more extensive landscape alteration than any other region in the U.S., and historic rates of species loss are likely the highest in the continental United States. There is continued strong development pressure on the land base, with rapid transitions of forest and farmland to residential, commercial, industrial and infrastructure development. Between 1974 and 1984, Delaware experienced a 15.4 percent net loss of its coniferous forest and a 7.1 percent net loss of deciduous forest to both farming and development; a 1.2 percent net loss of farmland (with large gross losses of farmland to development mostly offset by gross gains of farmland from forest); and a 4.5 percent net loss of coastal wetlands (Mackenzie 1989).

Between 1992 and 1997, Sussex County had the largest gross loss of forests (-17,000 acres) of the three counties in Delaware. This loss resulted from the largest percentage gains in residential acreage and in other urban uses in the state (Delaware Department of Agriculture, Forest Service 2001).

B. Physical Resources

1. Climate

The climate of the area is a temperate, humid one, with cool winters and warm summers. Winters are mild, with average December to March temperatures of 35-38 degrees Fahrenheit. Freezing in the marshes is irregular, occurring in January or February for a maximum of 2-4 weeks. Summers are hot and humid, with average temperatures in the mid 70's, with occasional 90 degree Fahrenheit days. Snowfall is extremely variable and may be non-existent or as much as 50 inches annually.

Table 1. Monthly Average Total Precipitation as Recorded at the Delaware Cooperative Extension Georgetown, DE

Month	Average Precipitation (inches)
January	3.9
February	3.02
March	4.58
April	3.46
May	3.84
June	3.09
July	3.58
August	5.22
September	3.49
October	3.42
November	3.56
December	3.18
Total	44.34

2. Soils/Water

Soils vary from marine tidal marsh soils in salt marshes, organic soils in freshwater wetlands, to a variety of sandy loams in the upland areas. Swamp soils are comprised of various mixtures of sand, silt, and clay. They are generally stratified but have no profile development. Tidal marsh soils are variously stratified but have no profile development, and often have buried peaty horizons.

The upland areas are comprised of loams, representing five series and ranging from well to poorly drained in nature. The upland soils belong to the Fallsington and Sassafras series.

The refuge contains three large, brackish and freshwater management units that are managed by a series of water control structures. Current habitat objectives focus on creating conditions for the growth of desirable vegetation which can be flooded to provide optimal feeding conditions for a variety of migrating and wintering waterbirds, including waterfowl, shorebirds and wading birds. Consideration is also given to other wetlands-dependent species, such as reptiles, amphibians, and invertebrates, but the primary management emphasis continues to be providing optimum habitat for wetland-dependent migratory birds.

C. Biological Resources

1. Vegetation and Fuels

Uplands

Most of the moderately- to well-drained portions of the refuge, which are now in agricultural fields, have been farmed for > 200 years. While these areas may be prescribed burned to prepare sites for agricultural use, they pose little fire hazards, due to low fuel loads and short vegetation (fuel model 1). Some of the cropland has been turned in to fallow fields, and may eventually be planted to native warm season grasses, such as little bluestem (*Schizachyrium scoparium*) and Indian grass (*Sorghastrum nutans*). Ongoing habitat management plans may possibly evaluate the potential to expand grasslands in some marginal croplands. In this scenario, prescribed fire will be critical to maintaining these early-successional habitats.

The timber and brush areas are seral stages which have developed as a result of field abandonment during the 1900's. Shrublands are dominated by coastal species such as wax myrtle (*Myrica cerifera*), marsh elder (*Iva frutescens*), groundsel tree (*Baccharis halimifolia*), button bush (*Cephalanthus occidentalis*), red cedar (*Juniperus virginiana*), green briar (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), trumpet creeper (*Campsis radicans*) and various blackberry species (*Rhus* sp.). Fire behavior fuel models in these habitats are generally models 5 and 6. In some cases, fuel models may be closer to 4; because wax myrtle contains aromatic compounds that are flammable, making it a potential fire hazard; red cedar foliage is also highly flammable.

Forested areas are usually seasonally wet habitats. These areas are dominated by red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), several species of oak (*Quercus* spp.), and sweet gum (*Liquidambar styraciflua*). Drier sites also contain loblolly pine (*Pinus taeda*) and Virginia pine (*Pinus virginiana*). Fuel models are generally model 8 and 9. Some areas contain extensive, dense vine growth in the understory, and dead lower branches, contributing to ladder fuels.

Wetlands

The tidal salt marshes on the Refuge are dominated by two basic plant associations. Saltmarsh cordgrass (*Spartina alterniflora*) dominates the regularly flooded portions of the marsh; the

dominant plant species in the irregularly flooded areas are the grasses collectively known as salt hay (*Spartina patens* and *Distichlis spicata*). Irregularly flooded marsh areas contains additional plant species, including marsh elder (*Baccharis halimifolia*) and big cordgrass (*Spartina cynosuroides*). Brackish marshes not invaded by common reed (*Phragmites australis*) are more diverse than salt marshes, dominated by species such as cattail (*Typha latifolia*), marsh hibiscus (*Hibiscus moscheutos*), bulrushes (*Scirpus* spp.) and smartweeds (*Polygonum* sp.). Freshwater marshes are the most diverse wetlands, containing pockets of wild millet (*Echinochloa walteri*), wild rice (*Zizania aquatica*), rice cutgrass (*Leersia oryzoides*), sedges (Cyperaceae), smartweeds, and beggar's ticks (*Bidens* spp.).

Extensive areas of wetlands on the refuge, in both the impoundments and the surrounding natural marshes, have become dominated by common reed (*Phragmites australis*). This species offers limited cover and little food value for migrating waterbirds, and has replaced diverse wetland plant communities that provide important migratory bird habitat. Stands of common reed are dense, and can accumulate high amounts of standing dead canes and litter. Fuel model 3 is used to estimate rates of spread in common reed stands, while fuel model 4 is used to estimate flame length and fire intensity.

2. Wildlife

Prime Hook NWR supports a wide variety of animal species. A total of 269 species of birds are listed for the refuge varying from abundant to rare. One hundred fifteen of these are known to nest on the refuge. There is also documented evidence of the presence of 40 species of mammals and 34 species of reptiles and amphibians.

The most conspicuous bird species are waterfowl, which occur in large numbers during the fall and winter. The shallow waters of the impoundments and salt marsh provide excellent feeding areas for numerous species of wading birds including large numbers of clapper rails. Shorebirds use the impoundments, salt marsh and bayshore extensively during migration. The concentration of migrating shorebirds which gather in the spring to feed on horseshoe crabs is of international significance. The salt marshes function as an important nursery area for several marine species of commercial interest especially the blue crab, American eel, white perch and rock fish.

The federally endangered Delmarva Peninsula fox squirrel was reintroduced to the refuge in 1986. Life history studies have shown that the squirrel generally prefers an open understory (Moncrief *et al.* 1993); refuge managers in the mid-Atlantic have begun to use prescribed fire experimentally to enhance forest habitats for Delmarva Peninsula Fox Squirrels.

D. Social/Economic/Cultural Resources

The landscape surrounding Prime Hook NWR is primarily agricultural, dominated by small woodlots, farm fields, and small vacation or retirement communities. Sussex County, DE, which contains the refuge, has a population is estimated at about 185,000 (Delaware Economic Development Office). The county is relatively sparsely populated; the largest towns in the area include the county seat, Georgetown, Lewes, and Rehoboth Beach. Over 100,000 seasonal visitors come to the county each year.

Sussex County Profile 2001). Sussex County is expected to grow by almost 35% to more than 181,000 persons in 2020 (Delaware Economic Development Office).

Agriculture and beach tourism are the dominant businesses in Sussex County, accounting for primary employment as well as spin-off employment in support industries such as farm machinery, fertilizers, and grain elevators. According to the Delaware Department of Agriculture and chicken industry trade association Delmarva Poultry Industry Inc., 71 percent of the state's cash farm income was from broiler chickens in 1999, with most of that coming from Sussex County. Delaware produced 251,700,000 broilers last year, down three percent from the previous year, ranking it ninth among the states in the number of broilers produced. Tourism is the county's second largest industry, with beach development rapidly increasing in Sussex County (Sussex County Profile 2001).

IV. Environmental Consequences

A. Soil and Water Resources

Alternative 1 - Full Suppression

Under this alternative, fire suppression activities such as mobilization of heavy equipment and crews, fire control efforts, mop-up, and associated operations could be more damaging to soils and sensitive habitats than the effects of the wildfire alone. Maintaining vegetative cover provides water quality benefits by reducing runoff and associated sedimentation. High intensity wildfires would result in increased soil erosion and siltation impacts due to greater damage to vegetation and root mats below the soil surface. Low intensity wildfires would likely result in minimal soil erosion and runoff problems due to lower impacts to vegetation and root systems.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

Implementation of prescribed fire in this alternative would minimize impacts on soil by controlling the area, timing, and intensity of fire. Direct soil impacts would result from preparation activities such as fire break construction. Soil impacts would be less than from Alternative 1 because heavy equipment and large crews and equipment would not be needed. Water quality impacts would be minimized because in prescribed burns, the location, timing, and intensity of the burns are carefully controlled. Increased use of prescribed fire should, in the long term, reduce the occurrence of wildfires due to reduction of fuel loading. Thus, the impact to soil and water quality, as outlined in Alternative 1, would be reduced.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

Allowing certain selected wildfires to burn as in this alternative could have negative impacts on soils and water quality because the exact timing, location, and intensity of the fire would be minimally controlled. Depending on the location and intensity of the fire, some soil erosion could occur due to reduced vegetation and plant litter. Intense fires would have more impact on vegetation with the resultant increase in soil erosion and sedimentation. Suppression and prescribed fire impacts would be similar to those outlined in Alternatives 1 and 2, above.

B. Vegetation and Fuels

Alternative 1 - Full Suppression

Using only the approach of prevention and suppression of all fires on PHNWR would preclude any management initiatives to use prescribed fire to alter habitat to manage for native plant communities. A decline in species diversity of vegetation and an increase in undesirable and non-native vegetation may result. Full suppression alone may allow the hazardous build-up of combustible fuels such as thatch or downed woody materials in certain areas which may result in hotter and larger wildfires. This may cause damage to sensitive plant communities. High fuel concentrations in stands of common reed will continue to build, posing serious wildfire threats to adjacent beach communities. Suppression impacts from tactical operations against large wildfires could cause adverse impacts in sensitive Refuge plant communities.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

Under this alternative, certain selected areas would be identified as desirable for burning to fulfill specific management and research goals in altering plant communities. Use of prescribed fire in very controlled ways would be performed in these areas. Increased Refuge plant diversity and reduction of nuisance and non-native vegetation would result, in some cases. Reduction of fuels would also result and may prevent or lessen the potential for wildfires in those areas in the future. Impacts of full suppression of any wildfires would be as outlined in Alternative 1, above.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

The most natural pattern of fire effects on vegetation would occur under this alternative. However, there is a greater likelihood that allowing certain uncontrolled wildfires would impact areas which have sensitive vegetation communities, vegetation management constraints, or social concerns (life and property). Thus, potential safety threats to these areas could negate any positive effects of this alternative. Full suppression and prescribed fire effects on vegetation and fuels would be as outlined in Alternatives 1 and 2, above.

C. Wildlife

Alternative 1-Full Suppression

Wildlife populations could be indirectly and negatively affected by suppression activities. Species dependent upon fire-influenced ecosystems could decline and be replaced by species more tolerant of conditions created when fire is removed as an ecological process. Inadvertent destruction of wildlife habitat and disruption to resident wildlife populations could occur with activities associated with fire suppression.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

Under this alternative, conditions favorable to fire dependent wildlife species would be simulated but not in the exact manner created by natural wildfire. The management of habitat types for the benefit of wildlife would be determined by prescribed fire location, timing, environmental conditions, and patterns of burning. Management efforts could be adjusted to simulate natural fire processes to provide a more natural distribution of fire influenced habitats. Prescribe fire could be used to stimulate plant growth, set back succession, increase community diversity, reduce non-native plant species (under certain conditions), and eliminate combustible fuels. Suppression impacts would be similar to those described in Alternative 1, above.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

The most natural distribution of habitats for the benefit of wildlife could occur under this alternative. In predetermined areas, wildland fire would be used to stimulate plant growth, increase diversity, reduce nonnative plant species, and eliminate combustible fuels. Fewer instances of negative man-affected changes would be imposed upon Refuge habitats than with Alternative 1 or 2. This effect would generally benefit wildlife species.

D. Endangered and Threatened Species

Alternative 1 - Full Suppression

Under this alternative, populations of fire dependent flora and fauna would be reduced by either a lack of fire, such as prescribed fire, or an unnaturally high intensity wildfire. Habitats for endangered species that are sensitive to fire will be unaffected in the short term, but could be damaged or eliminated by high intensity wildfire and/or the suppression activities used to extinguish it. The use of prescribed fire for the benefit of endangered or threatened species, such as the Delmarva Peninsula fox squirrel, would not be possible. Species that are not fire dependant and require undisturbed plant communities could show increases in population size.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

The controlled scheduling of prescribed fire under this alternative would allow a greater opportunity to plan for, locate, and avoid disturbance to threatened and endangered species during fire operations. Also, any species that benefit from prescribed burns could be accommodated. Fire suppression impacts would be similar to those described under Alternative 1, above.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

Selected random wildfires under this alternative may or may not benefit threatened or endangered species. Species which are fire dependent could benefit from allowing certain wildfires to burn. Sensitive populations could also be negatively impacted and not afforded the protections under Alternative 2, above. Prescribed burns and full suppression would have the same effects as in Alternatives 1 and 2, above.

E. Cultural Resources

Alternative 1 - Full Suppression

Known cultural resources would receive protection from wildfire under this alternative. Cultural resources susceptible to damage by fire could be degraded by high intensity fires beyond the ability of suppression forces to immediately control. High intensity fires are more likely to occur under this alternative due to the accumulation of combustible fuels resulting from full fire suppression. There would be an increased potential for damage to previously unrecorded cultural resources as a result of suppression activities.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

The scheduled nature of using prescribed fire under this alternative allows the ability to access, locate, and consequently avoid disturbance to cultural resources. The use of prescribed fire to prevent excess fuel accumulation could protect unrecorded cultural resources from the effects of wildfires. The potential impacts of suppression activities would be similar to those described under Alternative 1, above.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

Due to the unpredictability of ignitions under this alternative, unrecorded cultural resources could be affected by a wildfire before they could be identified and protected. Known cultural resources could be protected. Suppression impacts would be similar to those in Alternatives 1 and 2, above. Effects of prescribed fires would be similar to those described under Alternative 2, above.

F. Visual/Aesthetics/Airshed

Alternative 1 - Full Suppression

This alternative eliminates short term effects such as scorching of vegetation, which results from smaller, more frequent prescribed fires. Under this alternative infrequent, high-intensity wildfires are more probable and could result in considerable changes in the appearance of affected areas before suppression. Unsightly and potentially long lasting landscape scars could result from tactical suppression operations. Under this alternative there would be a short term reduction in the generation of particulate emissions from fires because of control actions. However, there is higher potential for severe episodes of air pollution due to large, uncontrolled wildfires.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

Areas with sensitive visual resources could be protected from fire and certain fire suppression activities under this alternative. Some visual changes would occur, but lower intensity and controlled prescribed fires would result in minimal changes to visual aesthetics. This alternative provides the highest degree of air quality management, by scheduling prescribed fire to coincide with periods of acceptable weather, wind direction, and velocity to minimize smoke in roadways and developed areas. Short-term smoke episodes would still be possible under this alternative, but fuels reduction by use of prescribed fire would greatly reduce episodes of severe air pollution due to large uncontrolled wildfires.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

This alternative could result in the greatest range of impacts on visual resources as a result of the various levels of fire intensity which could occur. Due to the unpredictable nature of wildfires, they could occur during poor weather conditions for smoke dispersal such as temperature inversions and air pollution alerts. Visual impacts from suppression would be similar to those described in Alternatives 1 and 2, above. Use of prescribed fire would produce visual and aesthetic impacts similar to those described in Alternative 2, above.

G. Visitor Use/Safety

Alternative 1 - Full Suppression

This alternative would result in minimal short term impacts to visitors. Visitor interpretation of the Refuge would be influenced by the unnatural composition of Refuge habitats. Due to accumulation of fuels and the higher probability of severe wildfires when they do occur, areas would be closed to the public while suppression activities are under way. Wildfire suppression is a hazardous activity. Safety risks associated with smaller prescribed fires are much compounded on larger high intensity wildfires, not only for the firefighters, but also for the public. Hazards include direct flame exposure, respiratory problems associated with smoke inhalation, and the use of heavy mechanized equipment under conditions of poor visibility.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

This alternative would entail some disruptive effects to Refuge visitors. Operational activities associated with prescribed burns would limit visitor use and access to portions of the Refuge.

Smoke production could detract from visual enjoyment and further restrict access on roads and trails. Activities associated with prescribed fire are accomplished in a safe manner through preplanning and scheduling of work tasks. Ignition is predetermined and designed to control fire intensity, and rate of spread. The hazards associated with wildfire suppression remain the same as those listed in Alternative 1, above.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

This alternative may provide the most natural habitat types for visitors to observe. However, due to the lack of control in the location, timing, and intensity of wildfires, visitors and Refuge neighbors could be inconvenienced. Initial safety hazards are lower under this alternative than under either Alternative 1 or 2 because of reduced fuel loading and thus a reduction in the probability of direct exposure to fire effects. However, the potential exists for more complex and longer duration incidents jeopardizing public safety and neighboring property owners. Adequate fire management personnel and equipment would be present during fire events for the protection of life and property. The hazards associated with wildfire suppression remain the same as those listed in Alternative 1, and the impacts of prescribed fire would be similar to those described under Alternative 2, above.

H. Economic

Alternative 1 - Full Suppression

Immediate suppression of potentially damaging wildfires would reduce the short term potential losses to high value capital improvements, both on and off-refuge. However, the suppression program could become quite costly because costs associated with the suppression program steadily increase with fuel accumulation. High intensity wildfires would be costly to suppress and could cause severe economical disruption through loss of natural resources, capital improvements, visitor access opportunities, and deteriorated visitor experiences.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

This alternative would allow a reduction of hazardous fuels near structures and other capital improvements and would reduce potential economic losses from a catastrophic fire. Prescribed burning would minimize the risk of escaped fires due to preplanning and specified environmental conditions within an approved prescription. Prescribed burning can be a cost-effective alternative to other implementation methods, such as mechanical.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

Under this alternative there is risk of economic loss if a selected wildfire escapes into an area where economic damage is likely. The potential losses associated with an escaped wildfire near housing developments along the PHNWR boundary could greatly exceed the costs of implementing either Alternative 1 or 2, above.

I. Overall Program Risk

Alternative 1 - Full Suppression:

In the short term, this alternative appears to provide the greatest protection from fire with the least associated risk. However, in the long term, this alternative jeopardizes natural systems on the Refuge which are dependent on fire for their perpetuation and creates unnatural fuel conditions that could potentially lead to a catastrophic wildfire in terms of resource and property damage.

Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires

This alternative presents the least amount of risk to PHNWR and public resources because prescribed fires are controlled and planned operations. They are carried out under a well-defined set of conditions and conducted by trained fire management specialists. Concurrently, non-planned ignitions would be suppressed. Prescribed fires would be used to manage against nonnative vegetation and for fire dependant native vegetation to benefit wildlife. Prescribed fire also may be used to provide habitat for wildlife species of concern.

Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

This alternative presents the highest degree of risk to PHNWR and public resources because of the potential duration and intensity of wildfire events. The large amount of fuels that could accumulate over time would make these fires difficult to suppress. A wildland fire would almost certainly move out of prescription parameters within a short period of time. The potential threat to off-Refuge development and human life would pose too great a risk to warrant a Wildland Fire Use program.

V. Potential Mitigating Measures for the Proposed Action

A. Smoke Impacts

The following steps will be taken to mitigate prescribed fire smoke on sensitive areas:

1. Smoke sensitive areas will be identified and addressed within the Annual Prescribed Fire Burn Plan. The direction of wind vector selected will be such that smoke and other particulate emissions are transported away from sensitive areas.
2. Burning will be conducted only when visibility exceeds 4 miles and when the fire weather forecasts indicate the presence of an unstable airmass, mixing heights of greater than 1500 feet, and ventilation rates (mixing heights X transport wind speed) of 3000 or greater. A minimum of 2 mph surface wind speed is required.
3. No burning will occur if any government agency has issued an air pollution health advisory, alert, warning, or emergency for the area surrounding PHNWR.
4. Backing and flanking fires will be used when possible to minimize particulate emissions.
5. Comply with State clean air requirements.

B. Sensitive Species/Resources

Endemic species distribution information will be reviewed when evaluating resources at risk to reduce impacts from fire management activities on sensitive species or habitats.

Available inventories and information concerning cultural resources will be consulted prior to implementing fire management activities with potential adverse impacts to cultural resources.

Suppression strategies will be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon natural and cultural resources. Minimum impact suppression strategies will be employed to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction will be conducted in such a way as to minimize long-term impacts to resources.

Within designated sensitive habitats, national policy will be followed to limit suppression tactics that will have long term, unnatural environmental effects. This includes limiting the use of retardant or heavy equipment to life-threatening situations without the specific approval of the Refuge Manager. However refuge staff will work with on scene fire chief to limit disturbance to culturally significant areas. These areas are small and should not significantly impact fighting wildland fires.

When suppression action is taken, rehabilitation will be undertaken. The most effective rehabilitation measure is prevention of impacts through careful planning and the use of minimum impact suppression techniques.

VI. Consultation and Coordination with Others

The intent of the fire management program at Prime Hook National Wildlife Refuge is to:

- 1) provide maximum habitat diversity for the benefit of wildlife;
- 2) to provide research opportunities on the best methods to control specific vegetation types with the use of prescribed fire and;
- 3) to protect and enhance natural resources in support of Refuge management goals and objectives.

Unwanted non-native vegetation types will be discouraged and desired native vegetation types will be encouraged by using prescribed fire as a management tool. These objectives support the overall management goals of Prime Hook National Wildlife Refuge. Section 7 consultation procedures and smoke management guidelines will be followed. Maintaining a good working relationship with the Delaware Department of Natural Resources and Environmental Control, Delaware Department of Agriculture, Forest Service and local fire departments will be essential to the overall success of the fire management program, and we will work closely with them.

This Environmental Assessment was sent to the three local fire departments, state bureau of Forestry, and to individuals or groups with an interest in fire management at the refuge. A legal notice announcing the availability of the Draft Environmental Assessment for public review and comment was placed in the local newspapers. We recieved a request form one member of the public for

No comments were received from the public.

U.S. Fish and Wildlife Service regional fire and biological personnel were contracted for internal review and authorization for Prime Hook NWR to pursue a prescribed burn program.

VII. Summary

There are major differences among the three alternatives proposed in this document. These alternatives were developed to find a suitable method of accomplishing the management objectives of the refuge, described in the Purpose and Need section of this document. These objectives were designed to manage wildfire and use prescribed fire to: provide maximum habitat diversity for the benefit of wildlife; provide research opportunities in the use of prescribed fire to manipulate vegetation communities; provide for the protection, restoration and maintenance of habitats required by endangered and threatened species; protect life and property; protect cultural resources; implement a safe and cost-effective program of resource protection and enhancement; and reduce hazardous fuels. The alternatives detailed in this document would accomplish these objectives to varying degrees. The implications of each of the three proposed alternatives are summarized below.

A. Alternative 1 - Full Suppression

This alternative would entail the suppression of all ignitions regardless of cause. All wildfires (both natural and man-caused) would be fully suppressed. No prescribed fires would be initiated under this alternative.

B. Alternative 2 - Use of Prescribed Fire and Full Suppression of All Wildfires (The Proposed Action)

This alternative would enable Prime Hook NWR to use prescribed fire in predetermined areas, within preplanned conditions, to accomplish specific resource management and research objectives. Fire hazards to life and property both on the refuge and adjacent would be reduced under this alternative. As in Alternative 1 (above), no wildfires would be allowed to burn without suppression.

C. Alternative 3 - Use of Prescribed Fire, Selected Wildfires, and Wildfire Suppression

This alternative would empower the refuge to allow wildfires to burn in certain zones under favorable conditions if specific management and research objectives are met. Prescribed fire would be used as a tool to fulfill the same objectives. Suppression would only be undertaken on fires that threaten life, property, resources, or which exceed prescription limits.

A no-action alternative of allowing all fires to burn at all times was initially considered but eventually dismissed as not suitable for further consideration in the development of this proposal. The no-action alternative was rejected because it failed to meet U.S. Fish and Wildlife Service policy regarding potential liability for loss of life and property, as well as unacceptable environmental, social, and economic risks and costs.

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